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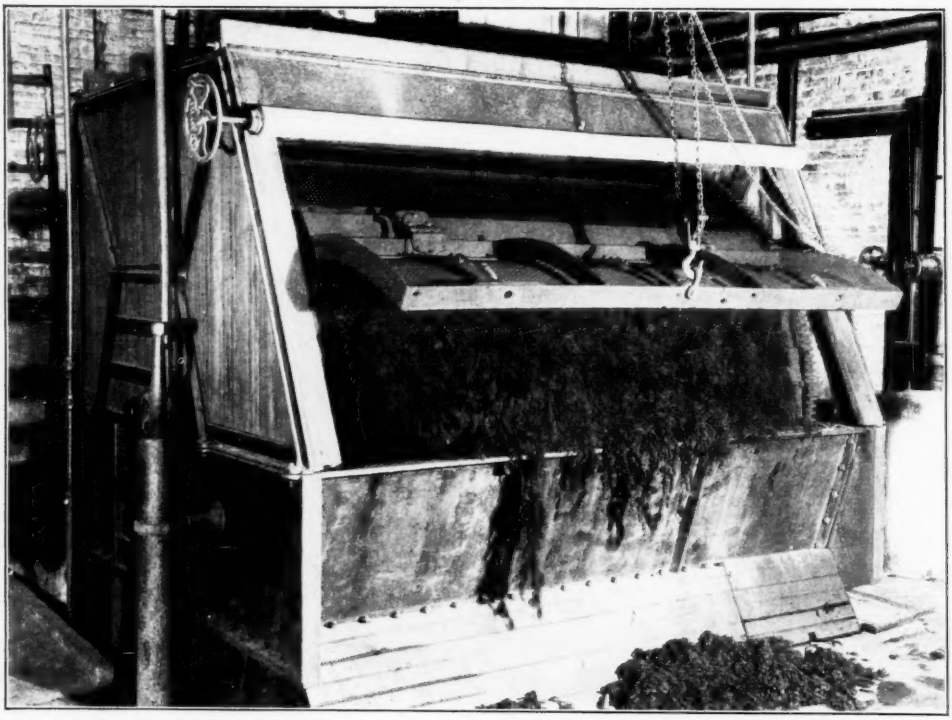

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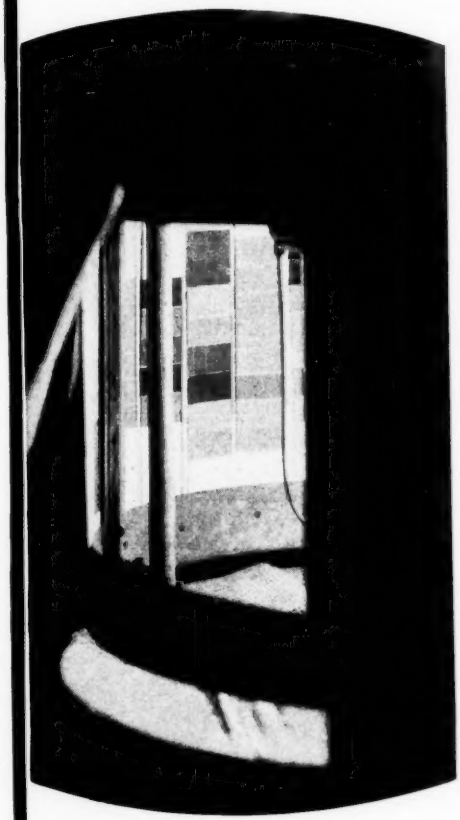

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Published by Howes Publishing Company, 440 Fourth Avenue, New York

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

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Tartaric Acid Mordanting Assistants

Their Function in the Economic and Uniform Fixation of Chrome Color Lakes on Wool

By AMOS K. HOBBY

W. C. Durfee Co., Inc.

Early methods of applying chrome mordants and subsequent introduction of the bichromates as mordanting principles are discussed. When used alone, or in the presence of sulphuric acid, a bichromate is reduced at the expense of the wool substance, but with the introduction of organic reducing agents such as tartar and oxalic acids as mordanting assistants, the wool is not only protected but a better penetration of the deposited mordant and subsequent color lake is obtained. These two organic acid mordanting assistants not only hold basic chromium compounds in solution during the mordanting process but maintain the activity of the deposited mordant later on. The top chrome and meta chrome methods of dyeing are discussed, and the belief is expressed that tartar not only produces a chrome bottom that cannot be equaled, but is also of great advantage if present in the dye bath when mordant acid dyes and a bichromate are being applied in the same bath and during the top chroming process with similar dyes.

IN THESE days of emphasized pressure for speed and low cost in dyeing operations, the writer is impressed with the fact that much is being saved at the spiggot, but much more is lost at the bung.

The old school dyer, for fast dyeings, was forced to rely on the "chrome-bottom" dyestuffs. First he used the natural dyewoods such as Logwood, Fustic, Flavine, etc. Then came the synthetic Alizarine and Anthracene dyestuffs. Then the Acid Chrome dyestuffs were developed.

Naturally the attention of the dyer was directed to methods of locating the necessary basic (violet or green) chromium compounds in the material to be dyed. His first attempts were directed to the application of Chrome Alum to the wool. This he found to be difficult to control, the acidic elements being rapidly taken up by the wool, leaving an erratic deposit of basic chromium compounds on the surface of the wool, giving blotchy dyeings. The addition of mineral acids helped penetration and distribution of the chromium, but kept most of the mordant out in the bath. The ideal assistant was found in tartaric acid (most economically supplied by argols or lees, by-products from the manufacture of wines). For some purposes oxalic acid was just as effective. Alum and tartar, and alum and oxalic acid became the standard mordants.

Some dyer then discovered that chromic acid has a natural affinity for the wool substance, and, with reasonable care, is very uniformly distributed. He applied this mordant by using bichromate of soda—or potash—and an acid such as sulphuric or acetic. This mordant was satisfactory for cheap goods, particularly when used to "fix" fustic and logwood—in fact the oxidizing power of the chromic acid in the fiber helps to develop the color of the logwood. When the dyer attempted to apply alizarine and synthetic chrome dyestuffs, he forcefully became aware of several things. Obviously the basic chromium (which is of course the essential element of all formation of chromium - dyestuffs combinations) could only be present to the extent that some oxidizable compound reduced the chromic acid. In other words, basic chromium can only be present to the extent that wool is destroyed. He also noticed that the chromic acid would "bleed" out into the dyebath, fouling the bath and producing "crock" on the goods. Still further, in many cases the dyeings were flat and dull, and often the shade injured. Comparing these dyeings with the results obtained on the "Alum and Tartar" mordant, the dyeings on the chromic acid mordant were harsh, flat—in short, markedly inferior to those made on the "Alum and Tartar" mordant.

The obvious result of these observations is the idea that good might result from the use of tartar with chromic acid, or the use of oxalic acid with chromic acid.

When the dyer tried these ideas he was very agreeably surprised. He found that the wool was protected by the tartar present and was no longer burned by the chromic acid and the consequent harshness was entirely eliminated. The dye compound was no longer located largely at the surface of the fiber, but distributed through it. Instead of having the character of a painted piece of wood, the fiber was now like a transparent piece of colored glass. A large piece of dyed goods now exhibited depth. Each thread was individualized, yet blended perfectly.

For a period, the dyer was well acquainted with, and well satisfied with the chrome and tartar, or chrome and oxalic, mordant. It was very level working (in fact may dyers prepared their woolen goods with chrome and tartar mordant to insure level and well penetrated dyeings with acid colors), and "foolproof," to quote some of the "oldtimers." In these two organic acids, the dyer obtained a combination of virtues found in no other available substances. Today the Chrome and Tartar process is even more than ever the approved method in the production of fine worsteds and woolens for men's wear by most of the recognized leaders in the industry. Both of these acids reduce chromic acid without the assistance of wool or other substance. When basic chromium is present in the bath, these two organic acids are able to keep it in perfect solution. Still more important is the carrying and penetrating power of these two acids, which carry the basic chromium past the surface into fibers and there distributes it throughout with wonderful uniformity. Equally important, these acids remain combined with the basic chromium after fixation in the wool and maintain complete activity of the mordant until displaced by the "dye-acid" or lake forming substances.

Any skeptic can convince and educate himself by boiling chromic acid with either of these two acids in direct comparison with other materials he thinks may have virtues. (Lactic acid, paper waste, "Lactamine," or even oil of vitriol, or formic acid.) Boil the materials together in glass beakers in the same concentration used in the mordant bath. Several things will become obvious.

1. Nothing happens. (Formic acid or oil of vitriol.) Indicating no reducing power.

2. Bath becomes brown and brown flocks separate. (Insoluble material.) (Lactic acid, or paper waste.) Indicating reducing power, but no control.

3. Bath becomes brown, green, or violet, but remains clear. (Tartaric acid, Half Refined Tartar, Oxalic acid.) Indicating reducing power and complete control.

The terms Argols, Tartar and Lees have been much abused. They have, in some cases, been offered as the approximate equivalent of Cream of Tartar, which is obviously not the case. These materials may contain from 5 per cent or less, to over 90 per cent of Cream of Tartar. The great majority of the so-called argols (usually the uncrystallized sediment which is more correctly termed—Lees) contain only 10 to 30 per cent Cream of Tartar. Much higher strength material can be and is imported. The point is that the term argol means absolutely nothing until its composition is specified.

A new era was brought about by the introduction of the top-chrome and metachrome methods of dyeing. This is made possible by the development of dyestuffs which can be applied to the wool as acid dyestuffs, the fast chromium lakes being subsequently developed by the addition of chromium compounds or by the chromium initially present. These methods have undoubted advantages. The operation is carried out in one bath. The time required is cut almost in half. The resulting dyeing is very fast and completely satisfactory in many ways when suitable dyestuffs are used. Excellent though these methods may be, a time comes when the dyer is forced to use the chromium mordant to get results obtainable in no other way. There is a tendency for a few dyers to consider the mere location of the chromium somewhere on the fiber as being the only necessary requirement. It is true that passable dyeing can be made on poor mordants. It is also true that a poor dyeing can be made on the best of mordants. That the best result should result from the best mordant dyed in the best way, is obvious.

In conclusion, it is our belief and experience that the use of tartar or oxalic acid produces a chrome bottom that can not be equaled in any other way. It is equally our belief that tartar can be employed with great advantage in the top chrome and the "chrome in the bath" methods.

New Elimination of Waste Campaigns Planned

"Interest in simplified practice and in standardization is increasing in the southeastern states," according to Geo. A. Cooper of the Division of Simplified Practice of the National Bureau of Standards, who has just completed a trip which included several of the industrial centers located in this section of the country.

Mr. Cooper further said that, "many southern industries are already cooperating with the division, and that state-wide simplification programs are now being arranged in Alabama and Florida. It is expected that the industries in many of the other states will take definite action.

"Elimination of waste programs are of particular concern to the members of trade associations, purchasing agents' associations and public utilities," he continued, "and these organizations are considering the simplification movement with renewed interest."

Foodstuff Dyes and Their Detection

By **FRED GROVE-PALMER, A.I.C.**

THE various sections of the Food and Drugs Act, which may be said to be the crowning event of the lifework of Dr. Harvey W. Wiley, have had the effect of making the road of the user of coloring matter in foodstuffs far less easy to travel than before; that effect is still being felt, but when it is remembered how widespread was the manipulation of the people's food previous to the passing of the Act, no one with the interests of the race at heart, will grumble at the restrictions imposed.

There can be no doubt of the need for the intervention of the law; it was of vital importance. We are not concerned here with the sophistication of foods and drugs with foreign matter, sand, or cheaper materials, but with the use of coloring substances that are definitely injurious to the health of the consumer. As a direct result of legislation, higher standards of purity have come to be normal practice, although it must be confessed that perfection has not yet been attained in all cases. Still, the passage of the "Pure Food Law," and similar enactments in various States, has led to a gradual weeding out of many of the malpractices formerly common.

It is perhaps not a little gratifying to know that the United States has led the world in the production, or at least, the investigation of dyestuffs that may be used in foodstuffs of all classes without endangering the health and life of the persons who partake of them. That similar enactments should be made international is really imperative. Unless this is done there will always be some person somewhere who, thinking more of immediate gain than of the consequences to other people, will use poisonous substances to make a better profit. Of this, two comparatively recent examples will be sufficient to emphasize the importance. A producer of large quantities of annatto, the principal coloring matter used by the milk products industry, found that his harvest had been badly dried and was very much off-color. In order that he might not lose the market, this genius decided to brighten it up by mixing red lead oxide with the dye. The consequences of this adulteration were felt all over the world, especially in the cheese trade. The other case occurred even more recently, in England, where a candy maker, in order to improve the appearance of his wares, rolled them in a white powder; such was the utter criminal carelessness of this man that instead of an innocuous powder being used, the one employed was pure arsenious oxide, and the results were disastrous.

As regards the use of dyestuffs for food purposes, there are three ways in which the matter is handled: in the United States, Australia and some other countries, a definite list of permitted colors is legalized; in others, certain dyestuffs are prohibited, the remainder beng tacitly allowed; in the third class there are no legal restrictions.

The use of such colors as the salts of copper was forbidden here long before it was in some other places; the coloring of dried green peas with copper sulphate is an example of this. Coppered peas were manufactured for export long after their use was illegal for domestic purposes. The employment of copper arsenite for green, and lead chromate for yellow, for the coloring of the cheaper forms of candies is well within the memory of many of us.

It has been argued that even if some of the synthetic dyestuffs which are used for tinting foods are poisonous, the quantity that can be taken into the human system is so small that no evil results can possibly be incurred; while admitting the *prima facie* truth of this, there is no doubt that accidents will happen, and just as careful people regard all guns as being loaded, so they will continue to eliminate from foodstuffs all possible or potential poisons. It is necessary, therefore, that foods should first be examined for the presence of colors added during the course of manufacture or preparation, and second, that the coloring matter should be examined with regard to its effect upon the human system.

The range of foodstuffs in which additive colors may be found is very wide and the reasons for the tinting may be popular demand for a certain shade, or to make the food appear to be of a better quality than it actually is. Thus, large quantities of butter and cheese are colored a rich yellow because the consumer prefers it, having become habituated to eating yellow substances of that class. There are even fashions in the color of butter; the tint favored in one district would be unsalable in another. Further, when it was suggested that in order to prevent unscrupulous dealers from passing off imitation butter as the real, the fake should be colored pink, the change was opposed because no one would bring

themselves to eat pink stuff on their bread, and an important industry would be ruined.

Among other foods that are shaded up, more or less legitimately, may be mentioned: sausages, dried herrings, conserves, candy, ice cream, jellies, cakes and confectionery of all classes, fruit-juices, and all the vast array of liquors, innocuous and otherwise; it has been said, in reference to some of the last mentioned, that the inclusion of a poisonous coloring matter might act as an antidote to some of the other ingredients.

Even when the color is put in without intent to deceive, the material used might not be a safe one; consequently examination should be made.

In the list here given will be found those dyestuffs which are permitted by law in this country, together with a few others that are generally believed to be quite harmless; the latter are indicated by an asterisk. All of them are soluble in water, except two of the yellows, which are noted. At the same time it is only fair to remember, that opinions differ as to how far the synthetic dyestuffs are harmless or otherwise. This matter was fully discussed by Hesse, in a paper on "Coal-tar Dyes Used in Foods," published in Bull. U. S. Dept. of Agric., No. 147, 1912. So great, however, is the interest taken in this subject, that individual factory batches must receive the Government certificate of purity before being passed for use. The annual value of the selected dyes which are sold as officially certified in this country is somewhere around $1,200,000.

Reds: Ponceaux 2R*, 3R, 4R, Amaranth, Erythrosine, Pure Bordeaux B*.

Orange: Orange I.

Yellows: Naphthol yellow S, Tartrazine, Yellow AB*, Yellow OB. (The two last are soluble in oil, not in water.)

Greens: Guinea green B, Light green SF*.

Blue: Indigotin. (Indigo disulphonic acid.)

It is of interest to note in passing that the Australian Commonwealth Government agrees in general with the American choice of certified dyestuffs for edible purposes.

In the main there would seem to be agreement on the point that definitely basic dyes, Saffranine is given as an example, and those in which there are nitro groups, are distinctly toxic in their effect, while those containing sulphonic groups are harmless for dietetic purposes; the introduction of a sulphonic group into a nitro dyestuff molecule removes its toxicity, according to A. G. Green*.

In this connection, it is well to recall that numbers of dyes have a value in medicine because of their physiological effect on the human body. Auramine and Methyl Violet, under other names, were used in surgery to prevent malignant growths, and in ophthalmic surgery to prevent suppuration; owing to their secondary effects, however, these dyes are not used for these purposes any more. Methylene blue has been used for deadening pain internally, and as an injection for malaria, Bright's disease and some forms of dysentery. During the War, the call for powerful antiseptics to sterilize wounds led to the use of Brilliant Green and Acriflavine (Trypaflavine) for this purpose. The last named is 3:6-diaminomethyacridine chloride; a cheaper variety known as Proflavine, was found to be almost equally good for the purpose; this is 3:6 diaminoacridine sulphate. Saffranine, Aniline blue, Alizarine yellow C (Gallacetophenone) are among a number of others that have been tried either as remedies for disease or as antiseptics, while the potassium salt of dinitro-O-cresol is used commercially as a preventive of fungoid growths and dryrot in cellars and lumber.

The dyestuffs belonging to the Fluorescine class have the property of producing photo-dynamic action when injected into the animal organism; use is made of this to prevent premature burial. If a solution is injected subcutaneously into a living body, it soon assumes a yellowish-green coloration, but if circulation has already stopped, this phenomenon, according to Icard, is not seen. This test is regarded by many scientists as the most reliable of all for this purpose.

Mineral colors containing mercury, lead, copper, zinc and barium are, of course, all poisonous.

Having considered the use and misuse of dyes in foodstuffs, it is now necessary to look to the means by which such coloring substances may be removed from the edible matter and examined. This is quite a simple process, consisting of transferring the dye from the preparation in which it is seen to a piece of white woolen fabric.

100 cc. of the liquid, or if it be a solid that is being examined, 50 grams in 50 cc. of distilled water, should be acidified with 1 cc. of hydrochloric acid. A small piece of the white woolen cloth, free from any dressing or sizing, is put in the liquid and boiled for a quarter of an hour, diluting further if required. In this way, all the coaltar dyestuff will be absorbed by the wool, together with some at least of the natural vegetable coloring matter, if any should be present. The woolen fabric having been rinsed several times in warm water, it is dropped into boiling water made slightly acid with hydrochloric as before, and is then boiled in dilute ammonia for a few minutes. This treatment should dissolve out all the synthetic dye and leave the wool stained with the natural color. The colored liquid is now acidified and a fresh piece of wool immersed in it; this is boiled again for a quarter of an hour, at the end of which time, the wool will be found dyed with the artificial dyestuff, and in that condition it can be examined for identification. Some workers prefer to have the dye still further purified;

(Continued on page 253)

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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CALENDAR OF COMING EVENTS

Council and Research Committees—
April 17—New York.
May 15—Boston.

* * *

Annual Meeting
December 4, 5—Boston.

* * *

Exhibition of Color at the Museum of the Peaceful Arts, 220. East 42nd Street, New York. Starts January 2nd and continues several months.

* * *

New York Section Meetings—
April 24—New York.
May 22—Paterson.

* * *

Northern New England Section Meetings—
May 2.

SIXTY-FIFTH MEETING, RESEARCH COMMITTEE

THE Sixty-Fifth Meeting of the Research Committee of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., Friday, March 20, 1931, at 2:40 P. M.

The following were present:

Chairman, Prof. L. A. Olney
J. R. Bonnar, representing A. E. Hirst
Hugh Christison
Ralph Culver
Harry R. Davies
Dr. Carl Z. Draves
W. C. Durfee
Henry D. Grimes
Walter E. Hadley
Dr. Milton Harris
Henry F. Herrmann
Wm. R. Moorhouse
George A. Moran
Dr. D. H. Powers
Walter S. Williams
P. J. Wood
Alex. Morrison, Secretary

Regrets at inability to attend were received from Messrs. Appel, Cady, Clayton, Harold, Hathorne, Lotte, Scott and Rose.

Dr. Milton Harris, our new Research Associate, was introduced to the members present.

The meeting was then given over to the discussion of policy and research program to be carried on by this Committee.

The individual members were requested to express their views on the matter of policy and to suggest research problems. In spite of the extemporaneous character of the remarks, many good points were brought out and several excellent subjects suggested for investigation.

The subjects offered for research were:

Iso-Electric Point of Wool.

Test for Determining Oxycellulose on Cotton.

Printing of Vat Colors on Wool.

Printing and Dyeing Acetate Rayon Fabrics.

Tests for Determining Whether or Not a Piece of Cloth Is in Condition for Dyeing.

Study of Dyestuffs to Determine What Produces Level Dyeing Properties.

Application of Vat Colors on Tubular Knit Goods.

Study of Carbonizing of Wool.

Investigation of Merits of Detergent Materials.

Study of Aging of Vat Colors.

Study of Cellulose, Action of Oxidizing Agents, Etc.

Study of the Chemical Action Taking Place When Silk Deteriorates Upon Exposure to Sunlight.

There were numerous views expressed in regard to policy but it was generally agreed that the problems we should immediately take up were ones that were of value to as many as possible and which can be completely finished in order to sell our Association to as many as possible. It was also agreed that our Association should work in close cooperation with the U. S. Institute for Textile Research. It was also felt that Dr. Harris should work on problems of fundamental research, but at the same time to coordinate them with their practical application, and also keep in touch with the work of our sub-Committee.

It was felt that the Research Committee as a whole was a too-unwieldy Committee to adopt efficiently a definite program and to direct the work of the Research Associates. It was therefore voted that a Committee of four be appointed to carry on this work, the Chairman of the Research Committee together with three other members whom he might appoint.

The Chairman asked for discussion on new features for the Year Book. A section to list trade names and constitution and uses of various commodities in use in textile mills had been proposed but general discussion led to the conclusion that it was not advisable.

A section devoted to conversion tables, etc., of general use to the chemical end of the textile industry was approved.

There also seemed to be a desire for an additional list of dyestuffs showing the more important imported dyes.

A letter from Mr. S. B. Barker, Director of Research, Wool Industries Research Committee, England, in regard to International Fastness Tests was referred to Chairman Olney and Messrs. Appel and Cady.

A letter from a Chicago Mail Order House in regard to Fastness to Washing Tests was referred to Chairman Olney.

The Chairman reported that Mr. Smith and Mr. Rybergh were at work at Lowell Textile Institute on the fastness to fulling tests for wool.

Hugh Christison reported progress on his standards for fastness to washing on wool. In this connection there was a considerable discussion as to whether staining of other fibers should be considered in establishing these standards or just the let-down of the shades be considered. This was taken under advisement by the Sub-Committee.

The meeting adjourned at 5:45 to meet in New York April 17th.

Respectfully submitted

ALEX MORRISON,
Secretary.

Peculiarities of Fading*

By WILLIAM H. CADY

A GOOD many persons are apparently laboring under the delusion that the fastness to light of any dye is something fixed and absolute, which can be determined with scientific accuracy and recorded with mathematical precision, and which, like the law of the Medes and Persians, "altereth not." It is my purpose tonight to show you that this notion is all wrong. If you will look in the literature issued by the various dye firms to illustrate their products you will find tables of fastness. The fastness to light is frequently expressed by numbers, running from 1 (very fugitive) to 8 (very fast). I maintain that these numbers are not dependable, because the fastness to light of a dye depends much upon a number of factors which are entirely independent of the dye itself. These factors will be discussed at considerable length.

I hope also during the course of this talk to give you a slight idea of the immense amount of time and thought and effort that has been expended by a multitude of workers during the last half-century in an attempt to find a really satisfactory method of making light tests; a problem which is not yet solved by any means.

We will first consider the reasons why the fastness of a dye is not always the same. In the first place, it depends on the depth of the dyeing. Our Light Committee

*Presented at the January meeting of the Northern New England Section.

noticed in classifying the fastness of the dyeings which we exposed in 1926 and 1927 (known as "Series 4") that where the same color was dyed in more than one percentage (for example, light, medium, and heavy, in the case of wool colors) the heavy dyeing was very much faster than the lighter dyeings. In fact, we found in some cases that a 5 per cent dyeing was from 8 to 16 times as fast as a 0.2 per cent dyeing of the same color. You cannot rate a dye like that in any one particular class or assign a specific number to it because it all depends on how heavy the dyeing is. That is the reason why our Committee classifies *dyeings* rather than *dyes.*

Further, the same dye is not necessarily equally fast on different fibers. Vat Indigo is faster on wool than on cotton; Methylene Blue is faster on cotton than on wool or on acetate silk; Malachite Green is faster on acetate silk than on cotton. And here is something curious. Malachite Green or Magenta dyed on acetate silk which has been partly saponified appears to be faster to light than when dyed on either unsaponified or fully saponified acetate silk. Mercerized cotton when dyed is said to be faster to light than unmercerized cotton.

The behavior of direct dyes on cotton when exposed to light is a good illustration of the effect of the fiber on the fastness. Direct dyes on cotton fade by reduction, rather than by oxidation. That has been well established by Harrison[1] in spite of the fact that most dyes fade by oxidation. It has been stated over and over again that you cannot make a dye fade unless you have both oxygen and moisture present[2]. But in the case of direct dyes on cotton there seems to be an exception, for as Harrison proved, certain direct dyes will fade on cotton in vacuo, when exposed to a strong light from a mercury lamp. If these same direct dyes are painted on *glass* and similarly exposed, they do not fade. The reason for this is that when these dyes are exposed on *cotton,* the light converts the cotton partially into oxycellulose, and the dye is correspondingly reduced, while on glass there is no such reducing action. Basic colors are just the opposite; they fade in air but not in vacuo. In other words, they require oxygen to make them fade.

In view of these facts, and of the necessity of having the fiber present when the dye is being faded, it is difficult to understand how Busby[3] could recommend exposing dyes in *solution,* or how Lasse[4] could expect to get accurate results by exposing porous clay plates saturated with dye solutions.

Another factor that affects fastness is the method of dyeing. As most of you know, mordants have a marked effect on some dyes. Gebhard[5] found that Malachite Green dyed on cotton on a Turkey-red oil mordant would fade in less than a week; but when it was dyed on tannin and antimony and topped with sodium metaphosphate and glucose, it would stand 10 or 12 weeks of sunlight without fading.

Another thing that varies the fastness of a dye is the nature of the finishing agents used. Since practically all cotton fabrics (not to mention other fibers) are treated with some kind of finishing compound after they are dyed, this factor ought not to be overlooked. Some of these finishing agents increase fading, particularly castor and coconut oils; olive and corn oils to a less degree. On the other hand, dextrine, glucose, and stearic acid have a tendency to retard fading[6].

Another important item is the source of light. Taking the sun alone, we get materially different fading whether we employ direct sunlight of north sky light. For example, it was found that to equal in north light the amount of fading produced by 48 hours of direct sunlight required anywhere from 3 to 61 days, according to the dye exposed[7]. Also, there is a material difference in the quality of the fading produced by direct sunlight and *cloudy sky* light, and a distinct difference between the fading produced only when the sun is shining and the fading which results from a continuous exposure, day and night and in all kinds of weather (under glass, of course). The factor of humidity (see below) doubtless has an important influence here. Further, the total amount of light energy radiating from the sun at any particular time varies enormously in different places; for example, it has been estimated that sunlight at the Arabian Sea is 42 times as bright as in Manchester, England. As we shall see a little later, lights which differ greatly in intensity are likely to differ also in the quality of their fading.

One factor that materially affects the fastness of dyes is the presence of moisture and gases in the air. Moisture, as every one known, is very important. Not only is it essential for fading, but some dyes are much more affected by moisture than are others [8], [26]. As regards gases, ammonia, alcohol and pyridine vapor, for example, increase fading [9], [10]. Sulphur dioxide is said to retard the fading of sulphur and azoic colors on cotton, but in the case of other dyes it retards some and accelerates others [11].

Finally, the fastness of a dye may be modified (for better or worse) by the presence of another dye in combination with it. I will refer to this in detail later on.

There are a number of dyes that have very peculiar behavior when exposed to light. Some fade rapidly at first and slow up later. Some are just the opposite[12]. Some dyes in a poor light may not show any perceptible change for a considerable time; then when the light is increased they start to fade quite rapidly. Some dyes fade "darker"[13]. A 50 per cent dyeing of Patent Blue A when exposed for 48 hours in the Fadeometer turns much blacker, and then on further exposure begins to go lighter.

A great many attempts have been made to standardize light fastness. Most of the efforts in this direction have

been directed at standardizing sunlight, particularly by the use of various devices for measuring the energy of the sun. One investigator[10] suggested exposing a solution of potassium iodide and sulphuric acid and measuring the amount of iodine liberated by the action of the sun's rays. The theory was, that if, whenever you exposed a dyeing to sunlight, you always exposed beside it a tube of this iodide solution, you could determine the total amount of radiant energy that had acted on the dyeing by merely analyzing the solution when the exposure was ended. In somewhat similar manner another man[10] used a solution of potassium ferricyanide in a sealed tube and determined the amount of ferric oxide liberated under the influence of the light. But the trouble with these methods is that they are fundamentally defective for the reason, already stated, that light fading depends on a number of factors besides the energy emanating from the sun.

Bancroft[14] advocated the use of the photoelectric cell as a means of measuring daylight in connection with the fading of dyes. To try out this suggestion, Appel[15] conducted a series of light tests at the Bureau of Standards, using a barium photoelectric cell (made by the Case Laboratory) to measure the amount of effective light falling on the samples. Twenty dyeings, representing a wide variety of dyes, were exposed in various ways, including comparisons of north and south light, sun and cloudy sky, and a continuous exposure, day and night, with an exposure to direct sunlight alone. The results were quite disappointing; although the fading was approximately equal, on the average, in each exposure, the total energy recorded by the cell varied tremendously, being at least four times as great in the exposure to sunlight alone as in the continuous day and night test. The conclusions drawn by Appel were as follows: "It is apparent that even when generous allowance is made for possible misjudgment of the amount of fading undergone by the samples, the quantity of energy received during exposure, represented by the area of the curve given by the photoelectric cell, does not correspond to the amount of fading."

Another method of standardizing sunlight makes use of a so-called "standard" dyeing, whose fastness is already known, and which is exposed beside the unknown samples until it has faded to a predetermined endpoint. The fastness of the unknown samples is estimated by comparing their fading with that of the standard. In one case[16] a dyeing of Indigo was used as a standard, and the actual amount of fading was measured by extracting the dyeing with acetic acid after exposure, and determining the exact amount of Indigo destroyed. This idea of using a standard of known fastness is a good one, and has been widely used for many years, though the selection of a proper standard has occasioned much discussion. In the earlier days a single standard was employed, usually a fugitive dye like Eosine or Victoria Blue, and when a fast color was being tested it was necessary to expose successively several pieces of the standard dyeing, replacing each one, as soon as it faded, with a fresh piece. The Krais Test Papers[17], devised by Dr. Paul Krais, of Dresden, Germany, are based on this principle. It is usually more desirable, however, to have a graded series of standards of various degrees of fastness, instead of only one; and the Echtheitskommission in Germany in its tables of fastness published in 1914[18] recommended for this purpose eight dyes each for cotton and wool, covering the whole range from very fugitive to very fast dyes. Similar standards were later selected for silk, rayon, and celanese[19]. There has been considerable criticism of these standards, particularly in England and the United States, and at the present time efforts are being made in all three countries to find better ones, and instead of a separate series of standards for each fiber, to have only one series, preferably on wool, for all purposes. It is hoped that ultimately all three countries will be able to come to an agreement on this important point.

Various substitutes for the sun have been proposed, and several actually used in the past, with more or less success. In the first place, there is the mercury vapor arc lamp. This was popular in the early days because it was at first supposed that the ideal fading lamp was a powerful light, rich in ultra-violet rays, and located close to the samples so as to shorten the time of exposure. Harrison[1] using a large Westinghouse mercury lamp, was able to obtain as much fading in an exposure of only 5 hours as was produced by Manchester sunlight in 170 hours. But this kind of fading is not dependable, for it was demonstrated by Harrison that the mercury lamp frequently gives a totally different kind of fading from sunlight, and that the more intense the light is, the more abnormal the fading. The trouble with the mercury lamp is caused by its short wave ultra-violet rays, which are not present in sunlight and which have not only a powerful fading action but a selective one, so that some dyes are more faded than by the sun, and others less. And yet the mercury lamp still has its supporters, and occasionally we find in the textile papers an article[20] recommending it as a source of light for fading purposes, on the ground that it is rapid in its action and rich in ultra-violet. It should be added, however, as Flynn[21] pointed out, that if the mercury arc is provided with a glass shield, which cuts out the short-wave rays, and if its intensity is reduced so that the rate of fading approximates that of the sun, it is capable of producing results which are comparable with sunlight fading. The "Uviarc Lamp"[22] (Cooper Hewitt) and the Hanovia water-cooled mercury arc[23] are based on this principle.

The white flaming arc is a lamp very little used at present for fading purposes, though twenty years ago it was better known. Although it has an entirely different

spectrum from the sun, it produces results which according to Mott[9] closely resemble sun fading.

The most convenient and widely-used fading lamp today is the violet carbon arc, better known as the "Fadeometer." It also has a different spectrum from the sun, and while its fading action resembles that of the sun in most cases, there are frequent exceptions. But for ordinary purposes, where extreme accuracy is not required, it is satisfactory. Within recent years, Himebaugh[24] has endeavored to improve the quality of its fading by installing a ventilating fan and a device for moistening the air, so as to keep both the temperature and the humidity at a constant level. This principle has been adopted in the later models of the Fadeometer. The English fading lamp "Fugitometer"[25] is constructed somewhat differently but is based on the same ideas. Controlling humidity and temperature seems to be a logical move, as both are important factors, and the temperature in a Fadeometer not equipped with a fan will rise excessively at times. As to the rapidity of fading of the violet carbon arc, compared with the sun, our experience indicates that six hours of June sun are about equalled (on the average) by 4-2/3 hours in the lamp, when the samples are at a distance of 10 inches from the arc, as in the Fadeometer.

The incandescent Mazda lamp has been thoroughly tried out for fading purposes by Appel[26]. The light from this lamp is too yellow when used in its natural state, but may be corrected by passage through a solution of copper sulphate, which also absorbs most of the heat and prevents scorching of the samples. After it has been so filtered, however, the light has lost much of its intensity and is rather too slow in its fading action, in comparison with other lamps. The quality of the fading is about equal to that of the Fadeometer, on the whole.

A tungsten arc lamp, known as the "Osram Pointlight"[27], made its appearance in Germany about five years ago, but does not appear to be well known in this country. It is an incandescent bulb filled with an inert gas and having two electrodes consisting essentially of tungsten. It has a continuous spectrum which is similar to that of the sun. It is not particularly rapid, but is said to imitate sunlight very well.

The relative merits of most of the lamps which have been described here are discussed at considerable length by Gordon[28] and in several reports of our Light Committee[29].

We come now to the subject of "combination fading," or the effect of one dye on another. It is well known that Indanthrene Blue GCD is an extremely fast dye, and Anthraflavone, or as it is now called, Anthra Yellow GC, is much less fast, and yet when the two are combined in one dyeing, the Yellow does not fade any more than the Blue. This curious phenomenon has been commented on by Gebhard[30] and other observers, but no attempt has been made to explain it. In this particular instance the Blue dye seems to retard the normal fading of the Yellow. But more often the opposite is true. If Helindone Yellow 3GN is topped with a fast dye, Brilliant Fast Blue B, and with a fugitive dye, Dianil Pure Blue pH, the resultant shades are about equally fugitive[30]. In other words, the Yellow has accelerated the fading of the fast Blue so that it is no better than the fugitive one.

Whittaker [31] states that Caledon Jade Green, when dyed in combination with Caledon Orange R, "fades completely away on a short exposure," although when dyed alone it is "among the fastest to light." Borho[32] also finds Jade Green sensitive to light in presence of various vat Yellows. In fact, the Green seems to fade more rapidly than the Yellows, as a rule.

Scholefield[33] found that when almost any vat Yellow or Orange was dyed on cotton and exposed to light while still in the leuco state, the cotton was badly tendered. He further observed that when a Blue like Ciba Blue 2B was dyed in combination with one of these Yellows, for example, Ciba Yellow G, and exposed to light in the leuco state, the Blue was destroyed in a few minutes. It should be noted that Indanthrene Yellow G is an exception to the rule, as this Yellow neither tenders the fiber nor accelerates the fading of other dyes.

Dr. Hans Meyer told me recently that Indanthrene Yellow GN Extra (not to be confused with G) has the property of accelerating the fading of other dyes when exposed to light; and when it is dyed in combination with Indigo or Brilliant Indigo, the Blue is completely destroyed on a short exposure. He attributes this to the fact that this Yellow contains an atom of sulphur in its molecule. Another dye containing sulphur, which acts similarly, is Diamine Fast Yellow FF. Scholefield[33] states that if this color is dyed on cotton and topped with Ciba Blue 2B and exposed to the Fadeometer in the leuco state, the Blue is destroyed in 10 minutes. It is interesting to note that in this case it is not a vat Yellow which does the damage, but a direct Yellow. This dye has a similar action on direct blues accelerating the fading of such colors as Benzo Fast Blue 4GL and Direct Fast Blue SFF. This is noteworthy, because it is a clean-cut case of a very fast dye making another fast dye fade, when exposed in a perfectly normal manner, either to the lamp or to the sun.

Harry Davies tells me that when Duranol Orange G is dyed in combination with Duranol Blue G on acetate silk, the Blue fades quite rapidly, although by itself it is very fast to light.

L. A. Lantz, Chief Chemist of the Calico Printers' Association of England, writes that if a combination of Alizanthrene Yellow GP and Indanthrene Brilliant Orange RK on cotton is exposed to light after aging,

while still in the reduced state, the Orange fades but not the Yellow. That is quite an interesting phenomenon, and deserves following up. He also mentions the fact that Chromazurine DN, Alliance Blue paste and Modern Violet DH are all "reasonably fast to light" when alone, but when Chromazurine DN is mixed with either of the others, the resulting mixtures are "very much poorer."

That is about all the evidence to date, and I admit that it is not very imposing. But there is enough to show that we have here a problem which is well worth studying, and if all our dye laboratories will collaborate, and if every observer who comes across an example of abnormal fading of this type will report the fact, a lot of valuable information will be assembled which not only will be of practical assistance to the dyer and colorist but will in time, I hope, lead to an explanation of the underlying causes themselves.

I will close with a brief reference to a few "freaks." It is well known that Indanthrene Yellow G, when dyed or printed on cotton and exposed to light, turns green; this being attributed to the reducing action of oxycellulose formed by the action of light on the cotton. It is curious to note that when Indanthrene Yellow G is printed on acetate silk and exposed to light, no greening takes place. If however, the acetate silk is first saponified by caustic soda, it then acts like cotton. Viscose, which should behave like cotton when similarly treated, actually seems to turn less green than either cotton or saponified acetate silk. Here is something that requires further investigation.

Indigo on cotton is one of the most eccentric dyes from the standpoint of light fastness. My attention was once called to an exposure of Indigo in the mercury lamp, which had faded almost as much on the back (away from the lamp) as on the face (towards the lamp). This was not due to the light passing through the dyeing, because the faded portions of the back did not correspond with the faded portion of the face. An investigation showed that the fading effect on the back of the dyeing was probably due to *air*, not *light*, and we were subsequently able to "fade" an Indigo dyeing by leaving it for six weeks hanging on the wall of a room, covered with black cardboard with an air space of one inch between the dyeing and the cover. When two Indigo dyeings were exposed to the light of the room, each covered with glass one inch above the dyeing, but with free circulation of air under one glass (A), while the air space under the other glass was entirely shut in (B), sample A faded while sample B did not. This "air effect" may perhaps be due to some impurity in the air, such as sulphur dioxide. It is easy to understand why cotton cloth dyed with Indigo and rolled up for printing is frequently faded on the outside layers, even if stored in a dim light.

The remaining "freaks" have to do with certain Indigosol dyeings on wool, which we exposed to the Fadeometer and unexpectedly "faded" much deeper in shade after only four hours of exposure. It turned out that the dyeings had been incompletely oxidized during the dyeing treatment (they were dyed in an acid bath and after-treated with chrome), and the light had merely completed the oxidation. After the color was fully developed (by the light), no further change took place for a long period. This is an interesting example of the oxidizing action of light.

It is obviously impossible in a paper of this length to do more than touch the high spots of such a large subject, but I hope that it may help a little to stimulate your interest in fading problems, and particularly in the subject of "combination fading," which has been almost entirely neglected in the past, but which seems to offer a real opportunity for research in the future.

References:
[1] J. Soc. Dyers & Col., July, 1912, p. 225.
[2] Dufton, J. Soc. Dyers & Col., 1894, p. 90.
[3] Tex. Col., June, 1922, p. 367.
[4] Textilber., 10: 618 (1929).
[5] Farb.-Ztg., Nov. 1, 1914, p. 393.
[6] Hannay, J. Soc. Dyers & Col., Jan., 1912, p. 20.
[7] Am. Dyestuff Rep., June 24, 1929, p. 416.
[8] Am. Dyestuff Rep., Nov. 14, 1927, p. 714.
[9] Mott, Chemical Engineer, Sept., 1915, p. 111.
[10] Brownlie, J. Soc. Dyers & Col., July, 1910, p. 191.
[11] Cunliffe, J. Soc. Dyers & Col., April, 1930, p. 108.
[12] Kischelt, J. Soc. Dyers & Col., Jan., 1895, p. 13.
[13] Am. Dyestuff Rep., June 24, 1929, p. 417.
[14] Am. Wool & Cot. Rep., Dec. 27, 1923, p. 12.
[15] Am. Dyestuff Rep., Nov. 14, 1927, p. 715.
[16] Scheurer & Brylinski, Bull. Soc. Ind. Mul., 1898, p. 273.
[17] Am. Dyestuff Rep., Jan. 5, 1931, p. 31.
[18] Am. Dyestuff Rep., Oct. 3, 1927, p. 611; Oct. 17, 1927, p. 641.
[19] Am. Dyestuff Rep., Oct. 31, 1927, p. 673; April 15, 1929, p. 235.
[20] Canadian Tex. J., July 12, 1928, p. 667.
[21] Am. Dyestuff Rep., Nov. 19, 1923, p. 837.
[22] Buttolph, Am. Dyestuff Rep., Feb. 12, 1923, p. 135.
[23] Anderson, Tex. Col., Sept., 1923, p. 576.
[24] Am. Dyestuff Rep., April 2, 1928, p. 217.
[25] J. Soc. Dyers & Col., Nov., 1928, p. 353; Cunliffe, ibid., July, 1929, p. 215.
[26] Am. Dyestuff Rep., Dec. 28, 1925, p. 882.
[27] Hochheim & Knebel, Am. Dyestuff Rep., Apr. 5, 1926, p. 227.
[28] Tex. Col., Jan., 1921, p. 29; Am. Dyestuff Rep., July 27, 1925, p. 488.
[29] Year Book, 1924, p. 73; Am. Dyestuff Rep., Jan. 14, 1924, p. 10; Nov 14, 1927, p. 707.
[30] Farb.-Ztg., Nov. 15, 1914, p. 405.
[31] "Dyeing With Coal-tar Colors," p. 133.
[32] Tex. World, June 21, 1930, p. 48.
[33] J. Soc. Dyers & Col., Sept., 1928, p. 268.

Dr. Chapin: I wanted to ask Mr. Cady whether he is familiar with the General Electric therapeutic lamp which has a little pool of mercury in the bottom of the lamp. It heats the mercury until it vaporizes, then an arc is

formed enclosed in the glass. It is supposed to have the quality of noon sunlight in summer time. It might be interesting to try it as a fading lamp.

The effect of one daye on the fading of another dye reminds me of the way dyes are used in photography when it is necessary to increase sensitiveness of a plate to a color such as red. They put in certain dyes. The object of the dye is to make light of some particular wave length, bring about greater chemical reaction in silver bromide on the plate.

This brings to my mind the question whether we have too many variables in differences of wave lengths of light that fade the sample. It seems almost an impossible problem to investigate each dye with each particular band of spectrum. But until something of this sort is done, I wonder if we shall know the fundamentals of fading. It is quite conceivable that a yellow dye might be affected more by one particular band of wave lengths, and a red dye by another. This probably is why the mercury vapor lamp, Fadeometer, and other sources of light have different fading characteristics.

Mr. Cady: It is interesting to note that in almost every case that has been cited, the fading has been caused by a yellow dye, and the dye that has faded is not a yellow, but some other color.

Dr. Chapin: That is, the yellow dye functions like the dye on a photographic plate, and the dye which fades functions like the silver bromide.

Dr. Scott: The question of the effect of different portions of the spectrum on the fading of dyestuffs has already been investigated to a certain extent by Mr. Appel at the Bureau of Standards under the direction of our sub-committee on light fastness. The report of this investigation was published in the June 25, 1928, issue of the AMERICAN DYESTUFF REPORTER. A selected series of dyeings were exposed to the action of sunlight under the following conditions: (1) with no intervening glass, (2) under glass which transmits a high percentage of ultra-violet light in addition to light throughout the visible spectrum, (3) under glass which cuts out practically all ultra-violet light but transmits the remainder of the spectrum, (4) under glass which transmits only ultra-violet light, (5) under glass which transmits chiefly blue light, and (6) under glass which transmits chiefly red light. I recollect that some of the dyeings faded just as much when all the ultra-violet light was excluded as when it was included. Other dyeings on the contrary faded much more rapidly when ultra-violet light was present. The results of these experiments were very interesting and I am convinced that a continuation of this work, as soon as convenient, would reflect great credit on our Association and materially broaden our conception of the principles of fading.

Mr. Christison: I would like to add to Mr. Cady's paper the abnormal behavior of logwood and Alizarine Yellow 2G. We found both in the laboratory and in practice that logwood dyed in conjunction with Alizarine Yellow 2G is comparatively faster than when dyed with fustic. It is some power that fustic has, that causes logwood when dyed with it to fade.

Mr. Grady: I would like to know if you find any difference in fastness between two dyes of the same type made by different manufacturers.

Mr. Cady: In the big series of exposures we made four years ago, we did sometimes by accident use dyeings of the same chemical dye made by two different manufacturers, and I recall only one case where the fading of the two products was sufficiently different to be noticeable.

As regards dyes that "fade darker", I might add that many of the dyes of the triphenylmethane family have this property.

A Member: What is the reason for the extreme fading which colors undergo in salt air? Why do the same colors fade more at the beach than in the city.

Mr. Cady: The humidity at the beach is the principal factor.

A Member: Would that be an oxidizing condition? What is the effect of the salt itself on the fastness to light. Or is it merely the reflection of the light on the water? It is a matter of considerable interest to the man with a nice set of curtains at the beach. They fade out in no time.

Dr. Chapin: Traces of sodium chloride from sea spray apparently fall in rain miles inland. Lines of equal sodium chloride content in soil run roughly parallel to the shore line. Sanitary surveys plot these to get a comparison between sodium chloride contamination and sodium chloride normally in the water supplies. So this excessive fading may be due to traces of salt in the atmosphere.

Mr. Choquette: Has any work been done on actual chemical analyses of the cloth? Does any chemical change take place in the cellulose during the fading of these vat colors that have been mentioned?

Mr. Cady: Apparently no analyses have yet been published. Both Scholefield and Landolt used the Methylene Blue test to show that oxycellulose was formed during the fading.

SEVENTY-FIRST COUNCIL MEETING

THE Seventy-First Council Meeting of the American Association of Textile Chemists and Colorists was held at the Chemists' Club, New York, N. Y., at 1:45 P. M.

The following were present:

President: P. J. Wood.

Councillors: Hugh Christison, Ralph F. Culver, Wm. R. Moorhouse, Walter M. Scott.

Councillors ex-officio: Robert H. Gaede, Chairman, New York Section, Dr. Carl Z. Draves, representing C.

A. Seibert, Chairman, Philadelphia Section. Prof. L. A. Olney, Chairman, Research Committee.

Secretary: Alex. Morrison.

Letters of regret at inability to attend were read from Past President, Dr. E. H. Killheffer, Vice President, H. A. Barnes, Chairman Piedmont Section, Samuel L. Hayes, Chairman Philadelphia Section, C. A. Seibert, the latter asking that Dr. Carl Z. Draves be his representative.

The Secretary's balance sheet was read as follows and approved:

Secretary's Balance Sheet—February 26, 1931

Cash on Hand January 14, 1931		$280.27
Receipts 1/15/31 to 2/26/31 Incl:		
Applications	28 @ $5.00	140.00
Dues	78 @ $5.00	390.00
Dues	1 @ $5.00	5.00
Corporate Dues		200.00
Year Book Sales	11 @ $3.00	33.00
Reporter Sales		1.00
Registration Annual Meeting		172.00
		$1,221.27
Disbursements:		
1/17/31 Exchange charge		.11
Cash on Hand Andover National Bank		1,221.16
		$1,221.27

The Treasurer's report was read as follows and approved:

GENERAL FUND

Balance as reported Jan. 16, 1931	$6,085.83	
Expenditures since Jan. 16, 1931	379.04	$5,706.79

RESEARCH FUND

Balance as reported Jan. 16, 1931	$4,607.75	
Expenditures since Jan. 16, 1931	250.00	$4,357.75
Balance		$10,064.54
Savings Bank	$6,431.21	
Checking Account	3,633.33	
		$10,064.54

The following were elected to membership as of thirty days after publication of their names provided no objection to any is registered with the Secretary:

ACTIVE:

Dolan, George J.—1402 East Pontiac St., Fort Wayne, Indiana. Asst. Dyer, Wayne Knitting Mills, Fort Wayne, Ind.

Grandage, Wm. W. Jr.—6808 Paschall Ave., West Philadelphia, Pa. Asst. Dyer, Kent Mfg. Co., Clifton Heights, Pa.

Green, Carl A.—342 Adelaide Ave., Providence, R. I. Asst. Dyer, Apponaug Co., Apponaug, R. I.

Lilly, J. M.—116 Park Ave., Schoolfield, Va. Piece-dye **Overseer, Dan River Mills**, Schoolfield, Va.

Linder, Robert W.—50 North 22nd St., East Orange, N. J. Textile Chemist, Waldrich Bleachery, Delawanna, N. J.

McAteer, J. R.—Lowell, N. C. Full Fashioned Dyer and Finisher, Hatch F. F. Hosiery Co., Belmont, N. C.

McLeod, Edward H.—335 Pennington Ave., Passaic, N. J. Colorist, Waldrich Bleachery, Delawanna, N. J.

Rooney, Henry T.—25 Dana St., Lawrence, Mass. Chemist, Pacific Mills, Worsted Div., Lawrence, Mass.

Turner, W. H.—51 St. Joseph St., St. Jerome, Que., Can. Dyer, Regent Knitting Mills, Ltd., St. Jerome, Que., Can.

Walker, H. A.—Morganton, N. C. Hosiery Dyer, Morgan F. F. Hosiery Co., Morganton, N. C.

Weiss, Mark W.—98 Tonawanda St., Dorchester, Mass. Research Chemist, Skinner & Sherman, Inc., 246 Stuart St., Boston, Mass.

JUNIOR:

Caswell, Ernest L.—6 Manchester Place, Providence, R. I. Chemist, Franklin Process Co., 564 Eddy St., Providence, R. I.

McGuire, Robert T.—156 Oakland Ave., Methuen, Mass. Asst. Dye Chemist, Pacific Print Works, Lawrence, Mass.

Puckett, Hugh—704 Grandin Road, Charlotte, N. C. Chemical Salesman, Chas. H. Stone, 822 W. Morehead St., Charlotte, N. C.

Smith, Peter C.—200 Harrison Ave., Lakewood, R. I. Laboratory Asst., Apponaug Co., Apponaug, R. I.

Wauters, Joseph L.—2518 Logan Blvd., Chicago, Ill. Asst. Dyer, Vassar Swiss Underwear Co., 2545 Diversey Blvd., Chicago, Ill.

ASSOCIATE:

Barber, A. James—530 Oakland Ave., Charlotte, N. C. Chemical Salesman, Solvay Sales Corp., 622 West Morehead St., Charlotte, N. C.

Clayman, Samuel—5611 Wyndale Ave., Philadelphia, Pa. Tech. Salesman, 126 Chestnut St., Philadelphia, Pa.

Dunkel, Paul A.—467 East 39th St., Paterson, N. J. Importers, Paul A. Dunkel & Co., Inc., 82 Wall St., New York, N. Y.

It was voted that Howes Publishing Co. dispose of reprints on Research as they were of no further value.

It was voted that the Section secretaries be again instructed to procure papers presented before the section meeting for publication in our proceedings and not to allow them to be used by other publications.

The President, being duly authorized, appointed Dr. Walter M. Scott as Chairman of the Program Committee for the next Council Meeting.

The President was authorized to appoint a Publicity Committee for the Annual Meeting as he deems best.

Prof. L. A. Olney and Dr. Walter M. Scott were appointed a Committee to work out a schedule for Annual Meetings rotating amongst the several local sections, and to report at the next Council Meeting.

A letter from Smithsonian Institution in regard to the Association furnishing an exhibit was read. Those present were asked to think this matter over and be ready to discuss the possibilities of an exhibit at the next meeting.

The recommendation of the Special Committee from the Research Committee appointed to engage new research men was accepted. The Committee recommended Dr. Milton Harris as a Research Associate to work at the Bureau of Standards and Bertyl A. Rybergh as a Research Assistant to work at Lowell Textile Institute.

It was voted that the meeting of the Council scheduled for New York April 17, 1931, be changed to April 10, 1931.

Chairman Robert H. Gaede of the New York Section gave the Council and Research Committee members present a cordial invitation to attend the meeting of the New York Section this evening and President Wood invited all who could to be his guests at the dinner preceding the meeting.

The meeting adjourned at 2:30 to meet next in Boston, March 20, 1931.

Respectfully submitted,

ALEX. MORRISON,
Secretary.

NORTH CAROLINA JUNIOR SECTION

THE North Carolina State College Junior Section of Textile Chemists and Colorists had as their guest recently, at the Textile School of North Carolina State College, Mr. James W. Black of the Ciba Company. Mr. Black graduated from N. C. State College in 1929 and is now a salesman for Ciba Company.

Mr. Black gave a very interesting lecture to the members of the Junior and Senior classes of the Textile School who are specializing in Textile Chemistry and Dyeing. Since graduating, he has been acquiring much practical knowledge in the dyeing industry and his lecture on "Color Matching in the Dye Manufacturer's Laboratory" followed by another lecture on "Application of Vat Dyes on Padding Machines" was received with much interest. He had various samples to show how satisfactorily these very fast dyes can be applied to piece goods by means of padding. His lecture was accompanied by drawings on the blackboard.

One of the classes was taken to the laboratory where Mr. Black demonstrated skein dyeing by use of Cibanone Blue R. This was practical work as the yarn is used in the weaving department of the Textile School. He showed the students particular methods of dyeing the yarn with the vat dye and pointed out important points relative to temperature, dissolving and reducing the dye.

The Junior Section was fortunate in having Mr. Black with them and feel that he and other practical men give valuable information in their talks and demonstrations.

Respectfully submitted,

D. B. HARDIN,
Secretary.

Treatment of Water for the Textile Plant

By ESKEL NORDELL
Technical Department, The Permutit Company

THE substance which is used in the greatest amount in the textile plant is water. In fact, the textile industry uses more water per pound of finished product than practically all other industries.

Water for the textile plant should be clear, soft and colorless. This fact has been recognized for years and the earliest plants in this country were built where abundant supplies of fairly soft natural waters were available. If these waters were turbid, they were filtered. If not, they were used "as is". As far as softening was concerned, no practical method of softening waters of under five grains hardness was then known. So if the water was fairly low in color, fairly low in turbidity and fairly low in hardness, it was considered entirely satisfactory.

Styles, however, have changed since those times. Different fabrics, different weaves, different materials and different shades have appeared and raised new difficulties in processing. Furthermore, the standards have been raised. It is necessary now to produce a higher grade of work than ever before. In the production of such work, the quality of the water used in the wet processing is of prime importance. Yet, too often, the textile man, in attempting to solve his difficulties, looks everywhere else but to the water supply. Water is too common, too cheap and entirely too innocuous-looking to receive the serious attention that it really deserves.

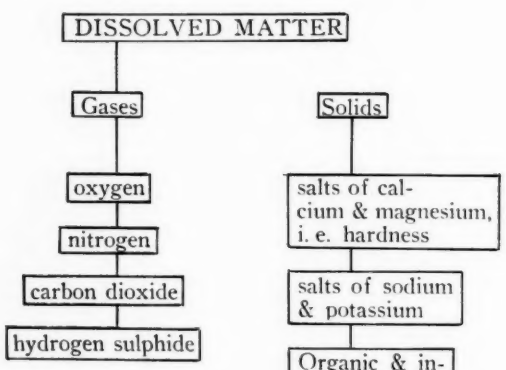
Now, if water were just pure H_2O, it would require little or no treatment. Pure water, however, is never found in nature. All natural waters are impure and the amounts and kinds of impurities vary greatly, depending on the local conditions. Even rain water is not pure. As the rain falls through the atmosphere, it comes in contact with dust, soot and gases. In the dust are found compounds of lime, magnesia and soda, also silica and iron oxide. The rain also dissolves the gases—oxygen, nitrogen and carbon-dioxide—out of the atmosphere.

As the rain falls on the earth, it comes in contact with more mineral matter, some of which may be dissolved and some of which may be disintegrated and carried along as suspended matter. A portion of the rain which falls, collects as surface waters, forming lakes, ponds and rivers. Another portion sinks down into the earth and forms the ground water supplies which may be obtained in the form of springs or wells.

The ground waters have an opportunity to come into contact with more mineral matter and such waters are usually harder than the surface waters. On the other hand, the percolation of the ground water has effected a filtration, so most ground waters contain very little color or turbidity. The surface waters are usually softer than the ground waters, but generally they contain suspended matter and color.

The impurities in water may be classified as follows:

IMPURITIES IN INDUSTRIAL WATER SUPPLIES



As shown above, the suspended matter found in surface waters may be divided into organic and inorganic matter. The organic matter may consist of living organisms such as bacteria, algae, etc., and dead animal or vegetable matter. Waste organic matter may also be introduced by sewage, factory wastes, including oil, and other waste matters which are discharged into the surface waters.

The suspended, inorganic material may consist of finely divided sand or silica, clay, iron oxide and alumina. The presence of suspended matter is always, of course, apparent to the eye and the amounts of it are usually determined by visual comparisons with standard samples containing known amounts of suspended matter. Suspended matter is generally classified as "turbidity" and the standards referred to are known as "standards of turbidity".

The amounts of suspended matter present in any given water supply may vary greatly from time to time depending upon the local conditions. Immediately after a rainfall, the suspended matter may be very high in amount. Many streams are so turbid during part of the spring months that they might be called muddy, while during the summer, they may run fairly clear. The suspended matter in a river will vary not only from season to season, but even from day to day. In the case of surface supplies drawn from lakes and ponds, the variations in turbidity are not likely to be so great as with rivers due to the fact that a considerable settling action occurs in large bodies of quiescent water, but even with such bodies of water, there are seasonal changes which may suddenly alter the turbidity very greatly.

This is especially the case with the changes known as the fall turnover and the spring turnover. At such times, temperature changes in the water cause the layers to shift so that the suspended matter lying at the bottom is stirred up and the whole body of water may become very roily and muddy.

Coagulation, Settling and Filtration

The suspended matter is extremely objectionable in textile work because it prevents the production of a clean product and, therefore, it is always necessary to remove it if one wishes to obtain the best results in process work. The removal of suspended matter is accomplished by coagulating the water with either an iron or an aluminum salt after which the bulk of the suspended matter is removed by passing the water slowly through a large settling tank and finally filtering the settled water. The coagulation not only helps in the settling of the insoluble matter but it also acts on the colloidal coloring matters which are present, thereby removing the color as well as the suspended matter from the water. The filtered water, therefore, can be made not only clear but also practically colorless.

While the above process sounds comparatively simple, it is necessary to exercise certain precautions in order to

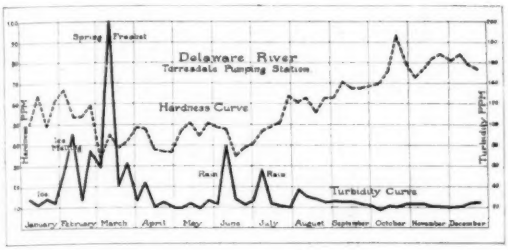


Fig. 1
All natural water supplies are constantly changing in composition, according to rains, droughts and freezing conditions.

obtain satisfactory results. The nature of the materials present in the water varies with different supplies and a special study should be made of the conditions obtaining with any supply before a specific treatment is recommended. It is then necessary to exercise chemical control, especially with the coagulation, so as to secure the best results.

The most commonly used coagulant is aluminum sulphate. Aluminum sulphate reacts with the alkalinity present in the water, thus producing aluminum hydroxide which is the gelatinous material which constitutes the so-called floc. If the alkalinity in the raw water is not sufficient, additional alkalinity must be supplied. This added alkalinity is usually supplied by feeding carefully measured amounts of sodium carbonate to the water. The addition of the aluminum sulphate must likewise be carefully controlled. It has been found that the formation of the alum floc takes place best within a certain limited pH range. While general rules for coagulation may be laid down, the optimum conditions are best determined for each particular water by making small scale tests, preferably on the scene.

With certain highly colored surface waters that are low in turbidity, it has been found advisable to add certain small amounts of suspended matter in order to accomplish the best color removal. The suspended matter that is generally added is clay and this is fed into the water by means of a dry feeding device appropriately called a clay feeder. The addition of the clay results in the formation of a better and heavier alumina floc and a more complete removal of the coloring matters present. Where settling tanks and filters are used without the aid of a coagulant, the filtered water is likely to contain not only the greater part of the color but also a small portion of the turbidity. In some plants, the coagulant is added by placing it in a bag and hanging this bag in the incoming stream to the settling tank. Such haphazard methods of feeding chemicals are not conducive to securing satisfactory results. Instead, the chemicals should be fed in carefully pre-determined quantities and added at an even rate. It is therefore necessary to exercise a competent supervision over this part of the water treatment. Such supervision is neither very arduous nor beyond the capabilities of an intelligent workman but it should be conscientiously carried out. It is therefore advisable to keep simple log sheets wherein the operator, at stated periods, enters the results of his tests.

It has been found that agitation during coagulation results not only in better floc formation with a consequently lessened period of time required for settling, but also that the color and turbidity removal are much more complete even with smaller quantities of coagulant. The resulting economies in chemicals, the improved quality of the effluent and the more positive control that can be exerted, make the installation of a mechanical agitator a dividend paying investment. Such agitators are usually installed in the downtake of the settling tank or at the inlet of the settling basin. The agitator proper consists of a series of paddles mounted on a shaft. It is usually driven by an electric motor and it is the usual practice to baffle the chamber in which the agitator revolves. The agitation not only assures a more intimate mixing of the coagulant with the water but it also results in a much quicker and better floc formation and a much more complete color and turbidity removal.

Many surface waters contain iron in the colloidal form and this iron is capable of passing through filters unless the water has been properly coagulated beforehand. There is no need of my dwelling on the fact that iron is a very troublesome material to have in the water of the textile plant. In deep well waters, iron is usually found in the form of soluble ferrous bicarbonate. This can be removed by base-exchange with zeolite or it can be removed by aeration which oxidizes the ferrous bicarbonate, resulting in the formation of insoluble ferric hydroxide which can then be removed by filtration.

Manganese is another trouble-maker that is found in some water supplies. Its removal is more difficult than the removal of iron but, with proper apparatus, very satisfactory results may be secured. Aeration at rather high pH values or treatment with special manganese zeolite have proven very satisfactory. With clear well waters, the base-exchange method has also proven efficacious.

Typical Flow Diagram

Figure 2 is a flow diagram showing one type of a coagulation, settling, filtration and zeolite softening plant. In this particular case, the river pump and the electro-chemical feed are simultaneously started or stopped by means of a float switch actuated by the level of the water in the settling tank. The electro-chemical feed lowers the swing drawoff pipe in the coagulant tank at a predetermined rate only while the river pump is operating. When the pump shuts off, the chemical feed simultaneously shuts off.

Since the pumping rate during operation is constant and the rate of lowering of the swing drawoff pipe is constant, the feeding of the coagulant is also constant and proportional to the amount of water being pumped. In this illustration, a coagulant feed only is shown. Where

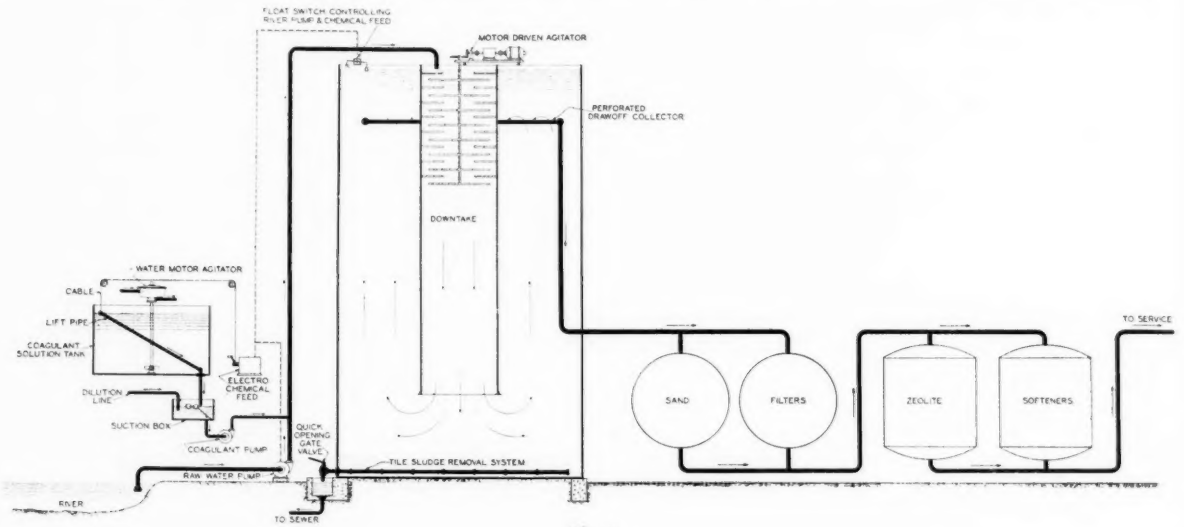


Fig. 2

it is necessary to feed alkali also, this may be fed simultaneously by the use of a second chemical tank holding a solution of sodium carbonate, the lowering of the swing drawoff pipe in this second tank being actuated by the same electro-chemical feeding device. In cases where the feeding of clay is also required, this is usually accomplished by means of a dry clay feeder.

The treated water then passes into the downtake of the settling tank where it is agitated sufficiently to cause the formation of a good heavy floc. It then passes down through the rest of the downtake and slowly rises to the drawoff pipe. During this slow passage through the tank, the great bulk of the floc settles to the bottom of the tank as a thick sludge which is periodically removed by means of the desludging system.

The settled water then passes through the sand filters where any remaining particles of floc are held on the sand bed. The filtered water should be clear and bright, free from turbidity and very low in color. The settled water in the top of the settling tank should be clear enough so that it can be used for cleansing the filters by the operation known as "backwashing".

Soluble Mineral Impurities

Having removed the turbidity and the color from the surface water by coagulation, settling and filtration, we will next consider what impurities may still be present in this clear, colorless water. It is convenient at this point to include also clear, colorless spring or well waters which do not require coagulation or any special processes to put them in proper condition for further treatment.

The principal mineral substances that may be present in such waters are the bicarbonates, the sulphates, the chlorides and (sometimes) the nitrates of calcium, magnesium and sodium. Small amounts of silica and alumina may also be present but these, usually, are of minor importance. Since the sodium salts are soluble; do not form scale; do not form insoluble compounds with soap or dyes and are usually present in fairly small amounts, they are of relatively slight importance in textile processing.

The same cannot be said, however, about the salts of calcium and magnesium. These are the two constituents to which the hardness in waters is due and the hardness in waters is very objectionable in nearly all industries. When such hard waters come in contact with soap, the lime and magnesia compounds in the water react with the soap, precipitating sticky, insoluble curds of lime and magnesia soaps.

Fig. 3
Cross-section and length of bagged boiler tube showing scale formation and effects due to the overheating caused by the scale.

When waters containing hardness are heated or especially when they are evaporated in boilers, a substance known as scale is produced. This scale may vary from a soft, chalk-like substance up to a very hard adherent, flint-like material. The softer scales are formed by the temporary hardness—that is, the bicarbonates of lime and magnesia present in the water. When a water is heated, these bicarbonates decompose, forming the carbonates which are less soluble and therefore are precipitated. The hard scales are usually due to calcium sulphate although

occasionally, a hard calcium silicate scale is also encountered.

We will now consider briefly the effects of the hardness forming constituents in textile processing and these may be considered under four main headings—Cotton, Wool, Silk and Rayon.

Cotton Processing

The following diagram is of the operations in manufacturing cotton goods.

In the diagram below, the wet processes are enclosed in double line boxes. The first wet process in this diagram is kier boiling, where it is absolutely essential to have a water that is clear and free from hardness, because the cotton packed in the kier itself acts as an excellent filtering medium for any suspended matter which may be present in the water supply. Any hardness present will form insoluble soaps in suspension and these will be filtered out by the cotton pack as the liquors circulate through there, so that when the cotton is taken out of the kier there may actually be a layer of these suspensions on the surface and it is usually found that the cotton which is the worst is that on the top and near the sides of the kier.

Of course, even in kier boiling with caustic soda alone, these insoluble soaps are formed when there is hardness present, because in the wax on the cotton there are also fatty acids, and these fatty acids react with the caustic soda to form sodium soaps; that is, soluble soaps, and these soluble soaps react with the lime and magnesia present to form the insoluble soaps. So the kier boiling, which is the foundation for good work in the rest of the cotton mill, is one of the most important steps in the manufacture, where it is necessary to use absolutely clear soft water.

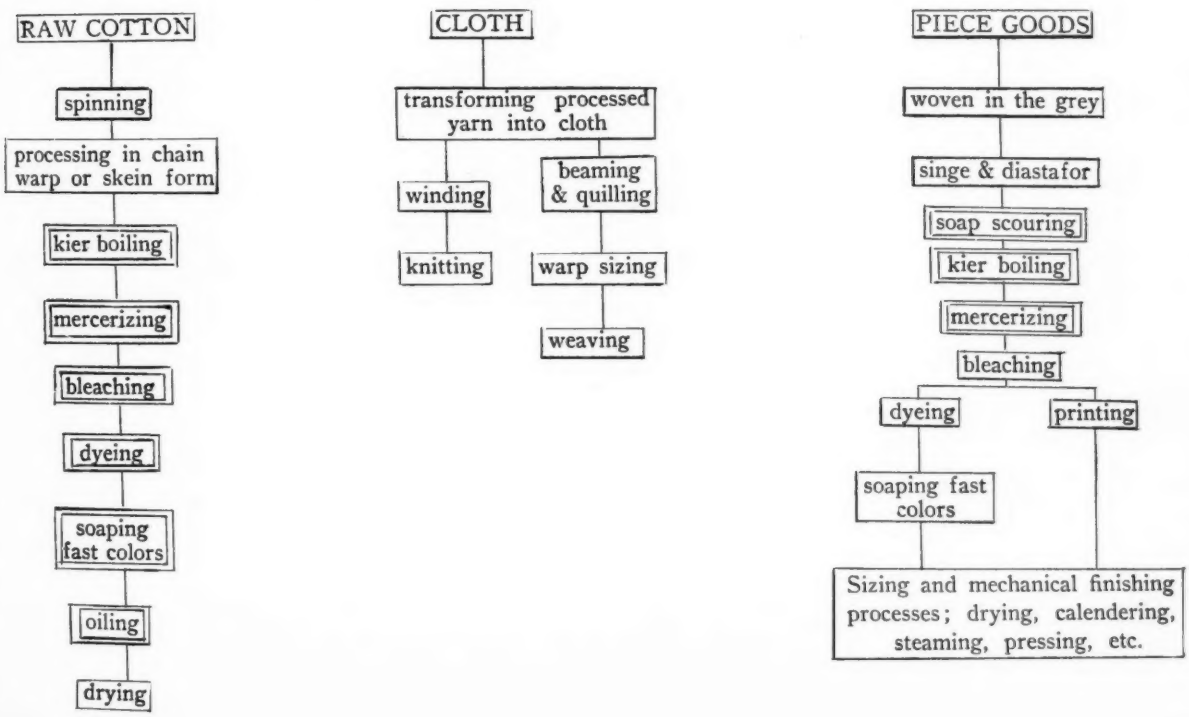
In the bleaching—that is, the application of the chemic, which is usually an alkaline solution of sodium hypochlorite—there is again danger of precipitations on the yarn, and it is advisable in the bleaching process to use water that is clear and free from hardness.

In the mercerizing, it is essential to have soft water throughout, for in the caustic immersion, if there is any hardness present, insoluble deposits may form on the surface of the yarn. If there are such deposits, it prevents an absolutely even penetration of the caustic liquors. That means that the yarn or cloth is not evenly mercerized, and that in turn means that the dyestuff will not be evenly absorbed when that yarn or cloth is later dyed.

In numerous cases, streaky dyeing in mercerized yarns and cloths have been eliminated by removing the hardness from the water used for the caustic immersions and for the rinses immediately following.

In the dyeing process in cotton, many of the dyes, particularly the substantive or direct colors, and the Indan-

OPERATIONS IN MANUFACTURING COTTON GOODS



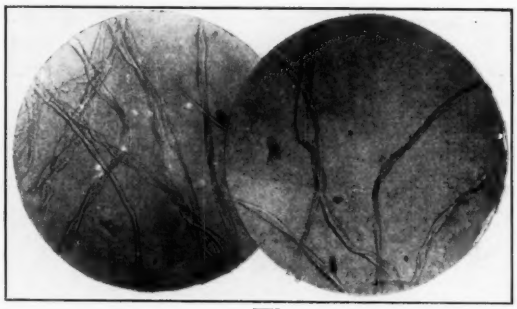


Fig. 4
Photomicrograph of cotton fibers washed in raw water (left) and washed in zeolite softened water (right). Note presence of insoluble lime soap curds on the fibers washed in raw water and absence on the fibers washed in zeolite softened water.

threnes and some of the other vat colors, form insoluble compounds with the lime and magnesia salts, and it is therefore essential to have the water absolutely free from hardness for those processes. Furthermore, in those classes of dyestuffs which form these insoluble compounds with the lime and magnesia salts, great economies are experienced by removing even small amounts of hardness from the water. This is of particular advantage in dyeing absolutely fast colors with the Indanthrenes, because some of these dyestuffs are very expensive. Similarly, these fast colors are usually soaped after dyeing, and for this soaping work, as usual, it becomes necessary to avoid hardness.

In processing in cloth-forms the same facts prevail for the soap scouring, kier boiling, mercerizing, bleaching, dyeing and soaping as those described for yarns above.

Wool Processing

Considering wool next, the following is a process diagram of a typical woolen mill and, in this diagram also, the wet processes have been enclosed in double line boxes.

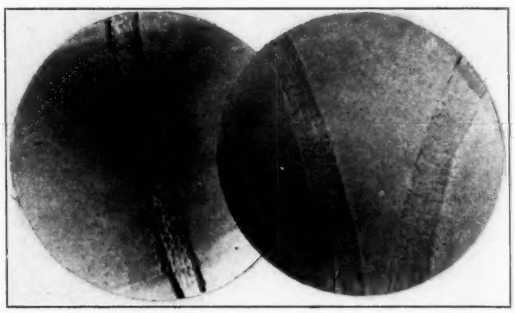
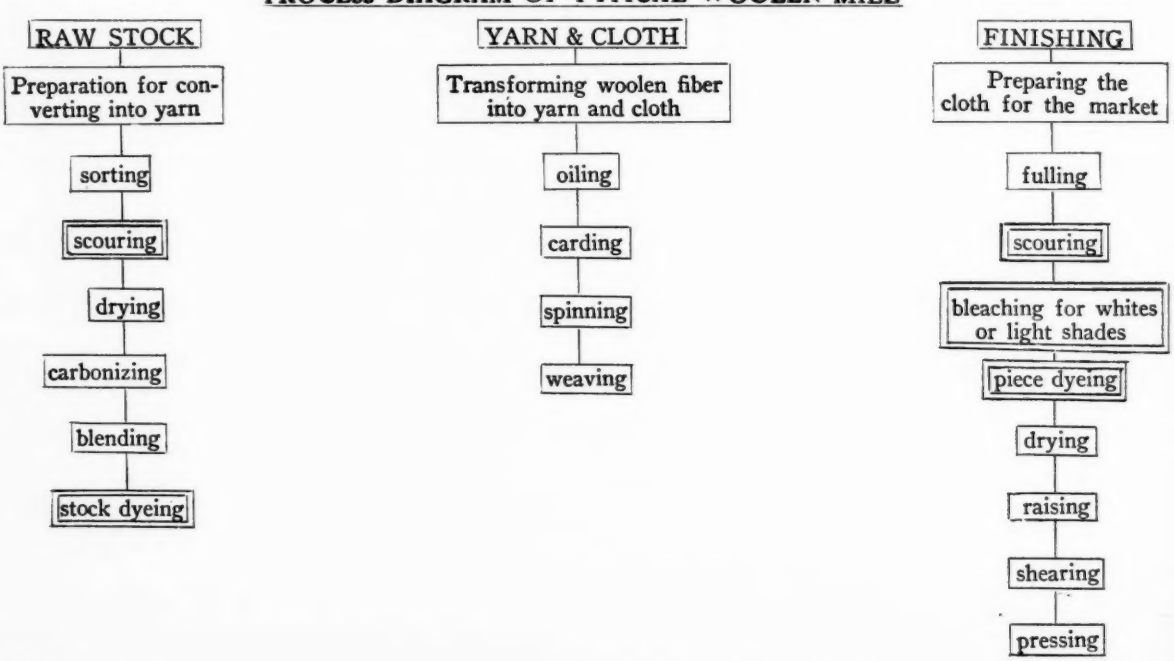


Fig. 5
Photomicrographs of wool fiber that have been scoured in raw water (left) and in zero water (right). Note how clean the fibers scoured in zero water are and how the insoluble lime and magnesia soaps stick to the fiber scoured in hard water.

In the wet processing of wool, the water used should be free from all hardness. The wool fiber has a fir cone structure which is ideal for holding the sticky, insoluble lime and magnesia soap curds formed when scouring with any water which contains hardness. This means that these insoluble soaps will interfere with all the future processing aside from the fact that tremendous quantities of soap and soda are wasted in the scouring baths.

PROCESS DIAGRAM OF TYPICAL WOOLEN MILL



Carding and spinning are merely mechanical processes, but these mechanical processes in wool show up very strongly the effects of either bad or good scouring. Often if you have a wool which is scoured in hard water, you will find that the little teeth in the cards become clogged from collecting the soap deposits that were on the surface of the fibers.

With the basic dyestuffs, it is absolutely essential to have soft water, because the basic dyestuffs as a class combine with calcium and magnesium to form insoluble compounds and the economies that result from the use of soft water here are great.

In the finishing plant, the processes involved are the same as those discussed above for stock and yarn scouring and dyeing.

Silk Processing

The following diagram is of silk processing and here also, the wet processes have been enclosed in double line boxes.

In the silk soaking before the reeling, it is a known fact that if any calcium or magnesium is present, the silk fiber absorbs it and that hardness makes the fibers brittle so that they break in the reeling. The same applies to the soap and oil soaking which precedes the throwing, except that here insoluble soaps also are formed which prevent the fiber running smoothly when the silk is thrown and increase the breakage tremendously.

In skein processing, the degumming for the removal of the sericin from the silk is carried out by immersing the silk in a soapy solution at the boiling point for anywhere from thirty minutes to a few hours, depending upon how far the degumming is to be carried and the quality of the goods being degummed.

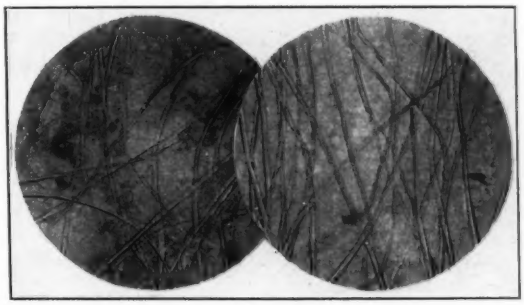


Fig. 6

Degumming silks in hard water results in the formation of insoluble soap curds as shown in left photomicrograph. Right photomicrograph is of silk fibers degummed in zeolite softened water.

Where hard water is used, attempts are made to soften the water in the degumming vat by the use of soda ash in connection with the soap. Of course, that sort of treatment in the vat is usually carried out very empirically. A man throws in so much soda ash, and he may add not quite enough, or he may add too much. Frequently he adds too much and the result of having free alkali in the silk degumming bath at boiling temperature is disastrous. As is well known, silk is affected by alkalies, and the luster is deadened, the fiber becomes more brittle, the feel is spoiled and the color is made yellowish.

Where water is absolutely free from hardness, it is unnecessary to use anything else in the degumming process except the pure olive oil soap in the water; the gum thereby is removed and the resulting fiber is soft and clean.

In tin weighting, the actual weighting solutions themselves—that is, the stannic chloride which is applied to the silk—do not cause any precipitation because the stannic chloride is an acid solution, but if the silk coming from the degumming bath has these precipitates all over it, there

FROM SILK COCOON TO FABRIC

will not be an even absorption of the tin salts, and as a result of that, the tin will not be fixed evenly throughout the fiber. Then, when the skeins are dyed, the portions of the fiber which ware not penetrated with the tin will not take that dyestuff as readily as those portions which have the advantage of the mordanting effect of the tin, and as a result of that, there will be what are frequently referred to as "hungry spots" in the dye silk goods; that is, the spots which have not taken the dyestuff as well as those parts that had the tin in them.

In the phosphate washes after the tin is applied, it is again necessary to use a soft water because sodium phosphate will precipitate the insoluble phosphates of lime and magnesia.

It is clear that in each branch of the industry, water is used in fundamental processes which affect practically all of the subsequent processes in the manufacture.

Rayon Processing

With rayon, the use of soft water is very essential. Rayon is a completely manufactured fiber and the quality of the water used has just as much effect on the final product as the quality of the wood pulp or cotton used. So important is this fact that the large rayon manufacturers have all installed water softening and treating plants even where they had a comparatively pure water supply, in order to make absolutely sure of having uniformly clear, colorless, soft water.

The dyestuffs used on rayon are to a large extent substantive. These are usually applied to the fiber in a neutral bath, frequently with the addition of soap or sulphonated oil. As stated previously, these dyestuffs usually combine with calcium and magnesium to form insoluble dyestuff compounds which result in streaks and blotches, as well as in the waste of the dyestuff itself. This is especially true of the costly fast colors.

The rayon fiber suffers a great decrease in strength when it is wet. It is therefore of the utmost importance to shorten all wet processes to the minimum and, since it is not permissible to boil in order to level out the shades, it becomes necessary to take every precaution to obtain uniform, level dyeing in the mimimum length of time. The extreme care required to obtain such results is further emphasized by the great range of shades and the accurate color matching demanded of this industry due to the use of rayon as a decorative yarn.

Zeolite Water Softening

The simplest and most complete way of removing hardness from a water supply is by the use of the zeolite water softener. This process was discovered about twenty-five years ago by a German chemist, Dr. Gans, and he coined the word "Permutit" for this process and also for the substances used in carrying out this process. Since the substances used belong to the class of minerals known as "zeolites," this process is generally known as the "zeolite" method of softening water. The principle involved in the softening process is that of base-exchange and the substances are also known as base-exchange silicates and the process as the base-exchange process.

The zeolite softener consists of a shell which contains a bed of granular zeolite some 2½′ to 5′ thick, resting on a supporting bed of graded gravel, the shell being

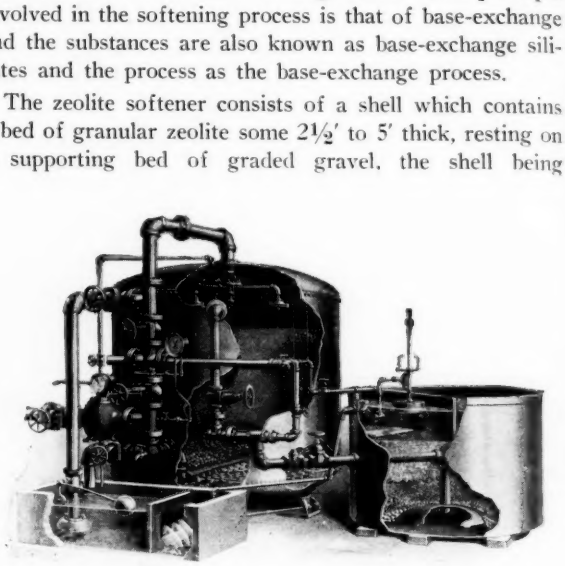


Fig. 7
Vertical Permutit Water Softener showing interiors of softener and brine tank.

equipped so that the hard water may be passed evenly through the zeolite bed and also so that the various steps required in the regeneration of the zeolite may be expeditiously carried out. The zeolite itself is a complex double silicate in a granular form. In order to soften water, it is only necessary to pass it through the zeolite bed. On coming in contact with the zeolite, the hard water gives up its lime and magnesium to the zeolite, receiving sodium in exchange thereof. For instance, if a water containing calcium and magnesium bicarbonates is softened by passing it through a zeolite softener, the effluent will be found to be almost entirely free of the bicarbonates of calcium and magnesium but will be found to contain the equivalent molecular amount of sodium bicarbonate.

Similarly, if the chlorides, sulphates or nitrates of calcium and magnesium are present in the hard water, then equivalent molecular amounts of sodium chloride, sodium sulphate or sodium nitrate will be found in the softened water. The abstraction of hardness that occurs in the zeolite bed is so complete that the effluent is practically free from calcium and magnesium and is therefore known as water of zero hardness or more simply as "zero water." Since zeolite is an insoluble substance, it is apparent that it is impossible to overtreat or undertreat a water by this process. The only effect of the ordinary variations in hardness which may be encountered are that if the water is harder, a correspondingly smaller amount of zero water will be obtained and if the raw water is softer,

then a correspondingly greater amount of zero water will be obtained.

After a certain quantity of hard water has been passed through the zeolite bed, the water softening capacity of the zeolite becomes exhausted. When this occurs, it is necessary to carry out the process known as "regeneration." In regeneration, a strong flow of water is first passed through the machine in the reverse direction to which the water was passed through on the softening run. In other words, this water is admitted at the bottom and flows out at the top whereas in the softening process, the water came in at the top and flowed out at the bottom. This reversed flow operation is called "backwashing" and it serves the double purpose of lifting and removing any insoluble matter which may have collected on top of the zeolite bed during the softening run and also to thoroughly loosen and hydraulically regrade the granules of zeolite which make up the bed. This backwashing operation is usually continued for about five minutes.

After backwashing, a measured quantity of saturated sodium chloride solution or, in other words, common salt brine, is introduced into the softener by means of a hydraulic ejector. The sodium chloride reacts with the spent or exhausted zeolite, forming the soluble chlorides of calcium and magnesium and restoring the zeolite to its original active or sodium condition. A quantity of water is then passed through the bed to wash these soluble calcium and magnesium chlorides and also the excess of sodium chloride to the sewer.

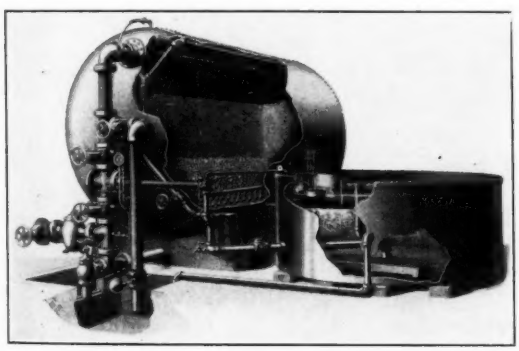


Fig. 8
Horizontal Permutit Water Softener with cut-outs showing interior construction of softener and brine tank.

After these salts have been washed out, the softener is ready to be put back into the lime. The entire operation of regeneration, including the backwashing, usually can be accomplished in about thirty minutes, although with the very large sizes, an extra ten minutes is sometimes required. Where storage space is not provided for soft water, it is advisable to use a multiple unit plant so that where one unit is taken out of the line for regeneration, the other unit or units will carry the full load, thus insuring an uninterrupted supply of zero water.

Soap Destruction in Waters of 1 to 4 Grains Hardness

Zero water does not form sticky, insoluble lime and magnesia soap curds and such insoluble soap curds are formed with all natural water supplies including those commonly known as natural soft waters. A natural soft water is simply a water which contains comparatively little hardness as contrasted with a natural hard water. However, it is not free from hardness and it does cause troubles in wet processing. Not only does this hardness cause processing difficulties and make the production of the highest grade of work either extremely difficult or impossible but also this hardness wastes large amounts of soap, soda and other mill supplies used in the wet processing. As an illustration of this, the following table worked out by the Laundryowners' National Association, Department of Research at the Mellon Institute, will prove of interest. I am quoting only that part of the table which shows the soap destruction in waters of 1, 2, 3 and 4 grains hardness and it is waters in this range of hardness which are commonly known as "natural soft waters."

Grains of Hardness	Pounds of Neutral soap consumed per 1,000 gallons of water	Cost of soap at 12c per pound
1	1.5	$0.18
2	3.0	0.36
3	4.5	0.54
4	6.0	0.72

In order to give an idea of the cost of the salt required to remove such amounts of hardness, we can use 1,000 gallons of 2 grain water as a base figure. In order to soften 1,000 gallons of 2 grain water by the zeolite process, it is necessary to use 1 lb. of salt for regeneration purposes. One pound of salt will cost from a little less than ½c to possibly 0.7c, depending on the location. Yet, from the above table, we can see that 1,000 gallons of 2 grain water uses up 3 lbs. of soap which at 12c per lb., is worth 36c. On the above basis, for the soap baths, the cost of the salt used with the zeolite softener is only about 2% of the cost of the soap destroyed by the hard water.

Researches conducted by Mr. Robbins of the Procter & Gamble Company on various mixtures of soap and alkali consumed by water of various degrees of hardness as compared with the amounts of soap and alkali necessary in zeolite softened water give results very similar in character, Mr. Robbins' figures for 50% soap and 50% soda ash, for instance, being 3 lbs. 8 oz. destroyed by the hardness present in 1,000 gallons of 2 grain water.

It is interesting to note that where processing is done in zeolite softened water, the highest grade of work is secured at the lowest processing cost. Besides the savings effected in soap and other scouring supplies, the zeolite softened water, when used in mill boilers, prevents the formation of scale and therefore effects very considerable savings in fuel, labor and repairs.

Dissolved Gases

Concerning the dissolved gases in water, these are principally oxygen, nitrogen and carbon dioxide. The nitrogen is absolutely inert but the same cannot be said about the other two. The presence of dissolved oxygen in water causes corrosion, especially in the hot water piping.

Concerning carbon dioxide, if the content of free carbon dioxide in a water is proportionately very high to the total alkalinity of the water, then the resulting lower pH value is likely to cause the corrosion due to the dissolved oxygen, to proceed at a faster rate. In other words, if dissolved oxygen corrosion takes place at a certain rate at one pH value, it is likely to proceed at an accelerated pace at a lowed pH value. Dissolved oxygen can be removed from a water by means of deaerating apparatus. The boiler feed water may be deaerated by means of an open feed water heater or deaerator in which a high enough temperature is carried to assure that the water actually boils and releases the dissolved oxygen. Vacuum deaerators are made to remove the dissolved oxygen from waters which are heated but must be used at temperatures below 212° F.

The deaeration of cold water has so far proved impractical. However, there are other ways of reducing, if not eliminating, dissolved oxygen corrosion. First, if the pH valve is too low, it may be raised by a proper feeding of alkaline chemicals. Second, a protective film may be built up on the metal surfaces by feeding a solution of sodium silicate or ordinary water glass to the water. The amounts so fed are very small, being only about 1/6 lb. of 40° Bé. sodium silicate per 1,000 gallons of water. Such treatments have proved very effective in a number of plants in cutting down the rate of corrosion in their pipe lines.

Where sulphur waters are encountered, the hydrogen sulphide is removed by aeration. The action is partly mechanical and partly chemical. The mechanical action, of course, is due to the "sweeping" action of the air passing through the water. The chemical action is an oxidation, the initial stage of which is an oxidation of the hydrogen of the hydrogen sulphide to water and a setting free of the sulphur. The finely divided sulphur may then slowly oxidize forming finally sulphates.

In the brief time allotted, it has been necessary to sketch only very briefly a number of phases of water treatment and water softening that may be of special interest to you. If so, it may be that these points are covered in one or more of these bulletins of ours and I will be pleased to send you the copies you desire if you will jot down their numbers. If there are any other questions, I will be pleased to answer them.

Dr. Chapin: Don't you have to be careful not to get the pH of the water too low before it goes into the softener?

Mr. Nordell: You mean under normal conditions? The pH does not affect the zeolite unless you had a water with such a low pH value that it would be acid to methyl orange so that it would attack the shell, and the plant piping system.

Dr. Chapin: I have brought along with the lantern a couple of slides illustrating Leeds & Northrup apparatus for automatically recording pH of water. If you are interested and will give me permission I should like to show them.

The first slide shows the potentiometer, which plots a continuous record of pH. It may be connected with a valve to control pH through automatic addition of chemicals. Beside it is an automatic compensator, recently devised to balance out errors from temperature fluctuation.

The second slide shows the cell which receives the flowing water sample and transmits its pH electrically to the recorder. It consists of a channel for the water, a calomel electrode, a gold or platinum electrode, and an arrangement for dripping quinhydrone solution into the sample just before it makes contact with the electrodes.

Mr. Grimes: How wide a range will it cover?

Dr. Chapin: Any range possible in filter practice.

Mr. Grimes: How do you determine the proper point at which to regenerate?

Mr. Nordell: Usually that is done in a very simple manner. We have an electrical alarm on the soft water meter and that rings when the rated capacity of the water softener has been delivered. The only test that is used with the zeolite softener is a simple soap test. This is made by taking a small shaker bottle and putting about 40 cc. of the water in the bottle and then adding a measured number of drops of a standard soap solution and shaking the bottle. If a lather is formed, the water is soft, and if not, it is hard. By means of this simple soap test, the operator can tell when to cut the softener out of or turn it back in service. On regeneration, when the salt is being washed out, the operator tastes the rinse water and then when the taste of salt has disappeared. he makes this simple soap test and that tells him when the softener is ready to throw back into action.

Mr. Grimes: Further question?

Mr. Nutting: I'd like to ask Mr. Nordell a question regarding the pH of different waters. As I understand it, the different waters in different sections have characteristics which set the optimum pH at different places. I have never been able to find out any satisfactory ex-

planation as to why one water should require one pH and another another pH for proper coagulation.

Mr. Nordell: In coagulating the harder waters where you have a larger amount of mineral matter and alkalinity present, you don't have to be so careful. With alum in the natural waters of relatively low hardness, the optimum condition is generally around from say 6.0 to 6.6. If you use an iron coagulant a pH of around 9 is advisable.

Mr. Nutting: As I understand it, the range you give is the optimum condition for the waters in this vicinity. Yet, in another locality there will be a different optimum pH range, and I can't understand why there should be different ranges.

Mr. Nordell: Well, usually it is in the way mentioned, that is, in waters that have a fairly high amount of mineral matter and bicarbonate alkalinity, you don't have to be so careful of the pH value. It is true that with certain waters we do find that the optimum conditions are best determined by experiment and may vary slightly. Of course, there is not a great variation in them, and even though you don't strike the optimum point, if you are fairly close to it, you will get quite satisfactory results. Very often we determine the amounts of alum and of soda needed experimentally and then take care to keep the pH within a certain limited range.

Prof. Olney: How does this water act with considerable amount of salt? That is, salt in the water passing through the zeolite?

Mr. Nordell: If you have in the water a very large amount of sodium chloride the softened water will not be quite zero water but may contain a fraction of a grain more of hardness. Also, you will not get quite the full capacity out of the bed. Suppose you have a water 20 grains hard containing 20 grams of sodium chloride. The effluent then would not be quite zero water, and you would not get quite as much capacity as if that salt were not present.

Mr. Grimes: We wish to acknowledge our appreciation to Walter Zillesson for securing President Wood at the meeting, and to acknowledge our thanks to Mr. Christison for securing Mr. Nordell as speaker on this subject.

NORTH CAROLINA JUNIOR SECTION

MR. R. VIEIRA, demonstrator for the Newport Chemical, Inc. was a guest of the North Carolina Junior Section of Textile Chemists and Colorists and spent an entire day giving lectures and demonstrations to the students of the Textile School. His principal subjects were, "Uses and Applications of Vat Dyes" and "The History of Vat Dyeing in the United States".

Mr. Vieira brought a large display of samples of various types of vat dyed and printed materials which he had collected from the different Southern mills. He showed the possibilities of securing a vat dye on heavier materials, which used to be considered impossible and stated that the old excuse of not being able to secure a good vat dye on various types of material is, now, a thing of the past because they are being used on practically everything that is desired to be dyed a fast color. He stressed the growth of vat dyeing in the south.

The three methods of applying vat dyes to piece goods were discussed, namely, the reduction and dyeing in the jig, pigment method and the continuous method. Mr. Vieira stated that all of these methods are being used and the type which is best depends upon the class of work to be done. Likewise, he discussed the method of dyeing raw stock with vat colors.

In the afternoon, Mr. Vieira demonstrated a practical method of applying vat dyes to the skein and package and showed various methods of testing dyed and printed materials.

The N. C. State College Junior Section appreciates such lectures and demonstrations from men like Mr. Vieira who have had many years of experience in the dyeing game.

Respectfully submitted,
D. B. HARDIN, *Secretary*.

RHODE ISLAND SECTION—JOINT MEETING WITH THE AMERICAN CHEMICAL SOCIETY

A JOINT meeting of the Rhode Island Section of the American Association of Textile Chemists & Colorists and the American Chemical Society was held on Thursday evening, March 12th, 1931, in the Jesse Metcalf Chemical Laboratory, Brown University.

Professor Harned of Yale University gave an interesting talk on "Dissociation of Weak Electrolytes in Salt Solutions."

About thirty members were present.

Respectfully submitted,
A. NEWTON GRAVES, *Secretary*.

MARCH MEETING OF RHODE ISLAND SECTION

A MEETING of the Rhode Island Section of the American Association of Textile Chemists and Colorists was held on Thursday evening, March 5th, 1931, in the rooms of the Providence Engineering Society.

Dr. E. W. Peirce of Ciba Company Inc. read an interesting paper on *"The Worries of Wool Dyeing."*

About eighty members were present.

Respectfully submitted,
A. NEWTON GRAVES, *Secretary*.

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Sauter, F. Albert, student, Clemson College, Clemson College, S. C. Sponsors: Chas. E. Mullin and Alfred R. Macormac.

Wauters, Joseph L., assistant dyer, Vassar Swiss Under. Co., Chicago, Ill. Sponsors: J. W. Eich and William Bergh.

SPRING MEETING OF PIEDMONT SECTION

THE Piedmont Section of the American Association of Textile Chemists and Colorists will hold their Spring Meeting in Greenville, South Carolina, at the Poinsett Hotel, May 2nd, 1931. The Banquet, which will start at 6:30 P. M., will be followed by a very interesting technical program, including a paper on "Selling the Textile Mills," by R. E. Sumner, Sales Manager of the Calco Chemical Co., Bound Brook, N. J., and also "Printing Textile Fabrics," by James Purcell, General Manager of the Clearwater Mfg. Company, Clearwater, South Carolina.

There will be a symposium on the question of bleaching cotton fabrics, in which the following methods will be discussed pro and con:

1. Lime and Caustic Soda boil with the Chlorine Bleach.
2. Single Caustic boil followed by Chlorine Bleach.
3. Double Caustic boil followed by Chlorine Bleach.
4. Desizing and Caustic boil followed by Chlorine Bleach.
5. Sodium Peroxide for bleaching.
6. Hydrogen Peroxide for bleaching.
7. Special compounds for bleaching.

There will also be an enjoyable entertainment program to round out the meeting.

Members of other sections are cordially invited to send in their reservations to the Secretary.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

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THE FUTURE OF CHEMISTS

A MAN well up in the chemical profession, some time ago estimated that it takes the average chemist seven years after graduation to earn $3,000, ten years to earn $4,000, and fifteen years to reach the $5,000 mark. He stated, as a result of his observations, that the average chemist at the height of his career could not expect to make over $4,000-$5,000 a year salary. This will mean that a man graduating at the age of twenty-two, will obtain $3,000 at the age of twenty-nine, $4,000 at the age of thirty-two, and possibly $5,000 at thirty-seven.

If this is true, one can readily see that the average chemist who has to start in at the bottom and work his way up without influence or the inheritance of money or having been born to an important position, is bound to die a comparatively poor man, provided he lives a normal life, has an average size family and properly educates his children.

The average chemist is expected to make a good appearance in public, pay annual dues to Technical and Fraternal organizations, contribute to the support of a church, purchase books and journals pertaining to the profession and contribute to endowment and research funds.

There may be a few self-made chemists driving Rolls-Royce automobiles, but not many. The average chemist dying at the age of sixty-five will be fortunate if he can leave an estate of $20,000 on earnings derived from his profession. It is one thing to leave money as a result of professional work and another to leave it as a result of inheritance or stock success. Many uneducated merchants would be ashamed to die if they knew they were to leave an estate of less than $20,000.

The average chemist in order to follow his profession must make use of laboratories and equipment furnished by others as he is not financially able to procure such equipment himself. He must give up the opportunity afforded in other professions for going into business for himself. Most of these professional men make far more money than the chemist.

Industry certainly owes a premium to the chemist for giving up the privilege of going into independent business, and should reward work well done with substantial salary increases. There are so many things to prove that the chemist is not paid according to value received from him that it is unnecessary to enumerate them. However, one chemist assisted in putting into operation a process that resulted in the plant saving several hundred dollars a day for the one line of work. In addition it enabled them to turn out a better product and get large orders on the work for several years. This chemist was not able to get an advance in salary as a result of this work. On the contrary, he even had the honor of having the superintendent give another man the credit for the work. Later on, this chemist saw a way to improve the product still further. A high-paid overseer, for selfish reasons, prevented the improvement.

At the present time there is no doubt that production men get higher pay than non-production men. In other words, if a chemist wants to make money he must abandon his laboratory. This is a sad state of affairs, but there is just a bit too much truth in it at present. If this same condition keeps on the industry will suffer. All the ambitious chemists will go into production work and only the mediocre will be left to carry on research work which has always been our mainstay for the advancement of industry.

Some steps should be taken to give the chemist an income proportional to his training and knowledge. The chemist must be able to answer intelligently any question concerning plant operations asked by the superintendents of slashing, dyeing, weaving and finishing. All these men receive more than the chemist and they have only one line of work to be familiar with. The chemist has to mercerize, bleach, print, and dye samples of gray cloth so that when they are sent to the customers they represent something that can be reproduced in the plant. Such work necessitates an excellent knowledge of plant operations and processes and should put the plant chemist on an equal footing with a divisional superintendent.

The less we say of the unfortunate situation of the textile industry for the past few years, the better. However, the chemist and the technical engineer, with proper backing, can do more for the industry today than any other group of men. Mill owners still allow high priced superintendents to purchase raw materials at exorbitant prices and thereby lose thousands of dollars yearly. Even a small percentage of this money would pay a chemist a salary comparable with that obtainable in other professions and still leave a large portion of the money as profit.

The trouble with the industry today is that it backs to the limit the rule of thumb, high-priced divisional superintendents who in many instances do not know the fundamental properties of their raw materials and yet do all in their power to prevent the chemist from putting these

materials into use scientifically. This does not mean that the chemist should replace these self-made superintendents. It means that the plant chemist should be on an equal with the superintendent in every way, including salary. When it comes to the management of help, the average technically trained man prefers to let some one else carry on. He prefers to be at liberty to carry on his experimental work and leave help management and carrying out of established processes to the superintendent. There should be room for both.

Polish Dyestuff Trade

The Polish production of, and foreign trade in, coal-tar and its derivatives during 1930 felt the adverse effects of the general depression. Despite the favorable forecasts with which the year began, the trade in coal-tar products experienced great difficulties throughout, with a decisive decline in the later months. According to reports received from the Chemical Union, stocks in the hands of manufacturers were much above normal at the end of the year, the revival expected as a result of cutting prices having failed to materialize. Forward buying, moreover, gave way to hand-to-mouth purchasing in most of the commodities, except refined naphthalene and benzol. There was a slackness in demand during 1930 on the part of the construction industry, one of the chief consumers of coal-tar products in Poland. Other consumers, such as the tar-paper and lumber industries, likewise decreased their buying of tar and impregnating oils. The heavy slump in the consumption of impregnating oils is attributable to the restricted purchase of railroad ties by the Government. On the whole, therefore, the production and trade in coal-tar and derivatives of the nine Upper Silesian coke plants were distinctly restricted in 1930.

Philip O. Schleussner

Philip O. Schleussner, 53, first vice president of the Roessler & Hasslacher Chemical Co., Inc., New York, N. Y., and an active figure in the drug and chemical industry for over 25 years, died on March 21 at his home, "Wood Acres," Stamford, Conn. He had been ill with bronchial pneumonia since last November. Private services were held at "Wood Acres" on March 23, interment taking place at Woodlawn Cemetery.

To his many friends in the chemical industry both here and abroad, Mr. Schleussner was always an interesting personage. A genial disposition and kindly interest in his fellow men won for him a host of friends.

Philip O. Schleussner was born in Brooklyn, N. Y., on September 6, 1878, the son of Charles and Ida Schleussner. A public school education was followed by a few years of work in the textile industry. His next position was with the Heyden Chemical Works, New York City. He left this company in 1906 to take charge of the Platinum Division of The Roessler and Hasslacher Chemical Co., New York. He was then 28 and just starting to show some of the ability which in the next 15 years of association with R & H carried him to the position of manager of sales for all the company's products. Other advancement followed rapidly. In 1923, he was elected secretary and made director of the company and in 1928, Mr. Schleussner became first vice president. Along with these activities, Mr. Schleussner was an official and director in other associated companies of R & H. These included the Perth Amboy Chemical Works division, Perth Amboy, N. J., the Cia Mexicana de Productos Quimicos Roessler & Hasslacher, Mexico. He was vice president and chairman of the executive committee of the Niacet Chemicals Corp., Niagara Falls, N. Y.

Hercules Advertising Manager Dies

Wilmington, Del., Apr. 6.—Nelson S. Greensfelder, advertising manager of Hercules Powder Company and nationally known authority on industrial advertising, died here Sunday morning, April 5.

The end came suddenly after a short illness which quickly developed into pneumonia. He is survived by his wife, Grace Gleason Greensfelder, and seven-year-old son, Robert J., and by his parents, Judge and Mrs. J. B. Greensfelder, Kirkwood, Missouri.

Mr. Greensfelder was born in St. Louis County, Missouri, March 20, 1891. He attended Colorado College and later the Colorado School of Mines, graduating in 1913 as an Engineer of Mines. He entered the employ of Hercules Powder Company as a salesman and demonstrator and upon showing ability as a writer and advertiser was transferred to the home offices in Wilmington. He became advertising manager in 1924.

A number of his activities brought Greensfelder into national prominence. One of the organizers of the National Industrial Advertisers' Association, he became its president and represented the organization at the world advertising institute in Berlin, Germany, in 1929.

He was director of "The Explosives Engineer," published by the Hercules Powder Company, a magazine of international circulation sponsoring safer and better methods of using explosives. Through "The Explosives Engineer" he was instrumental in instituting the National Safety Competition, annually awarding trophies to the winners of this competition.

Towards a Science of Physical Metallurgy

The Oxford University Press will shortly publish a book called The Metallic State: Electrical Properties and Theories, by W. Hume-Rothery ($9.00). "It has become increasingly apparent," says the author in his Preface, "that Physical Metallurgy is at present in an unsatisfactory position, largely owing to the lack of collaboration which has existed between Physics, Chemistry, and Metallurgy." This book provides an important essay towards the development of a connected science of Physical Metallurgy. It is divided into two parts, one dealing with the facts and the other with the theories. It is a very complete general survey of the subject. A second volume on Alloy Structures will follow.

Foodstuff Dyes

(Continued from page 230)

for this they strip the fabric once more with ammonia and work on the solution.

The actual identification of the dyestuff that has been used is a matter of some difficulty as it may be one or more of several, but the necessary knowledge of procedure, together with a study of the analytical tables that have been drawn up, will go a long way towards a solution of the problem. Considerations of space will not permit the reproduction here of all the tables, which are long and intricate, but a single example, adapted from Green's "Analysis of Dyestuffs," will be enough to show the general idea underlying the methods of detection.

It is supposed that a red dye has been found; this is soluble in water, and a few drops of a solution of tannic acid produce no precipitate; this eliminates basic dyes. A piece of white cotton warmed in the solution without acid is not dyed; this cuts out substantive dyes. The dye is reduced by boiling it with zinc-dust and acetic acid, the color being thus discharged, indicating an acid dye. If the decolorized wool is exposed to the action of the air and the color comes back, it is proof that the dye used is an unauthorized one belonging, maybe, to the Azines, Pyrones, etc. If the color does not return until the wool is spotted with acid permanganate solution, the dyes should be dissolved in water and shaken up with ether. Transfer of the color to the layer of ether indicates the presence of one of the Eosines or Phloxines, such as are often used to tint cherries and other fruit. The permitted red in this class is Erythrosine, but the others are not usually regarded as being harmful.

If, on the other hand, the color is not brought back either by exposure to air or by spotting with permanganate, two small pieces of woolen cloth should be boiled in the solution of the dye to which a few drops of very dilute formic acid has been added. One of the pieces of wool should have been previously treated with a solution of potassium chromate (3 per cent.) for one hour at the boil. The two dyed bits are well rinsed and then boiled with dilute ammonia (1:100). If there is no change in the color, the dye belongs to the acid-mordant class and is therefore not justified in use, but if the color is stripped from both patterns, and the liquor is red, it is one of the acid dyes, among which Amaranth and the Ponceaux are numbered. The final identification must be made by comparison with patterns dyed to various strengths of the authorized dyes and kept as standards.

Preserved fruits and conserves are sometimes found to contain dyestuffs of the phthalein class which are neither basic nor acid, and yet, in the arrangement of the molecule, partake of both. Such colors are readily soluble in chloroform on shaking with an acidified solution of the foodstuff. If the solvent is evaporated off, the dye should be dissolved in a small quantity of ammoniated water and then dyed on to a piece of silk; it can then be examined more fully.

Exceptional brightness of tint might lead to the suspicion that one of the basic dyes had been used. In this case a sample of the food is boiled with water to extract the dye which is tested on a piece of mordanted cotton cloth. The quickest method of making this is to work the fabric, free from dress and sizing, in a one per cent bath of tannic acid for an hour at 60 deg. C. It is squeezed out well and left damp for four hours, and is then worked for fifteen minutes in a one per cent bath of tartar emetic at 40 deg. C. Follows rinsing in warm and cold water, after which the fabric is dried out and kept for use as required.

Many dyes can be extracted by shaking an acidulated solution with ether, obtaining the coloring matter when the solvent has been evaporated, as in the case of chloroform.

Occasionally, the presence of really poisonous dyestuffs of unsulphonated nitro class, such as Picric acid, Victoria yellow and Martius yellow, can be detected in cakes and biscuits, and similar dry solid foods; the simplest method adopted for the purpose of finding these is to press a sheet of white paper on to the suspected body with a hot iron. The dyes, being volatile when heated in this way, will stain the paper characteristically.

Certified food colorings carry their own guarantee of fitness, but any others that happen to be used, even though they may be accompanied by the guarantee of a reputable firm of manufacturers, should not be taken on trust; something may have happened to the shipment in transit, or somebody may have cased up the wrong material. There is nothing unusual in either of these suggestions; it happened in the case of the arsenic covered candies mentioned earlier; a man was told to bring the cask of white powder from the store; he brought 'any' white powder and it proved to be a death-dealing poison instead of the harmless dusting powder that was wanted. Sheer, unutterable carelessness, criminal neglect of safety. One case like that is sufficient to show how vitally important it is to test and check every package of every shipment; it is impossible to be too cautious in a matter of this kind as, apart from the risk to the consumer, there is the fatal damage to the reputation of the people who make the mistake.

* Analysis of Dyestuffs, London, 1920, p. 53.

In a new sample card "Shades Fast to Fulling on Worsted Yarn," given out by the General Dyestuff Corporation, a wide range of combination shades are shown, produced with Chrometopped Colors of very good fastness to fulling and light. I. G.-326.

Dyers' Accounts, VI

Preparing Accounts for Income-Tax Purposes—Ascertaining Taxable Profits from Cash Records—Methods of Determining and Recording Depreciation

By S. HOWARD WITHEY, F.C.I.

BETWEEN the term "net profit," as understood by the dyer, and the term "taxable income," as understood by the income-tax authorities, there is a big difference, for although the credit balance shown in the dyer's annual profit and loss account will represent the amount of profit actually realised during the year, this figure will have to be subjected to very considerable adjustment in order to arrive at the amount of profit for tax purposes under Schedule D. Some of the items which have been charged against profits by the dyer, and which have had the effect of reducing the final balance, will not be allowed to stand as statutory deductions, while on the other hand the dyer may be entitled, as a taxpayer, to relief in respect of certain transactions apart from those included in the ordinary profit and loss account.

To ascertain the amount of taxable profit it is necessary to prepare a special income-tax profit and loss account showing on the right hand or credit side the net profit as on the ordinary profit and loss account, followed by the various items not allowed as statutory deductions, and on the debit side the various allowances to which the dyer is legally entitled. If any items of the following nature have been charged against the periodical profits, the amounts involved will have to be added to the net profit when preparing this special income-tax account:—

(*a*) The cost of additions or improvements to business premises, including the wages paid to any of the dyer's employees who may have been engaged in carrying out the improvements.

(*b*) The cost of buying additional plant, machinery, furniture, fittings, etc.

(*c*) Depreciation written off the book value of the business premises, machinery, or any other assets employed for profit-earning purposes.

(*d*) Sums which have been added to a reserve or to a suspense account.

(*e*) Amounts withdrawn from the business by the dyer or by any partner, including payments made to an inactive partner, interest on capital, etc. The dyer cannot draw any remuneration as distinct from a share of the profits.

(*f*) Expenses of a personal or private nature not directly connected with the business.

(*g*) Amounts representing ground rent, annual interest, etc., from which income-tax should have been deducted by the dyer at the time of payment.

Dr. PROFIT AND LOSS ACCOUNT—YEAR ENDED JUNE 30, 1930 *Cr.*

	£	s.	d.		£	s.	d.
To Wages	1,811	2	7	By Gross Profit Transferred from Trading Account	2,671	14	5
To Rates and Local Taxes	56	8	2	By Dividends received	12	15	6
To Income-Tax	11	10	0	By Rent received	72	10	0
To Mortgage Interest	10	10	0				
To Depreciation	25	0	0				
To Repairs to Premises	12	6	8				
To Goodwill written off	25	10	0				
To Drawings (Private)	200	0	0				
To Carriage and Cartage	17	19	6				
To Stamps, Postages, etc	20	7	9				
To Agents' Commissions	43	2	9				
To Advertising and Insurance	52	10	0				
To Bad Debts written off	7	1	6				
To Sundry Trade Expenses	59	11	8				
To Balance, being net profit for the year	403	19	4				
	£2,756	19	11		£2,756	19	11

This Profit and Loss Account is Referred to on the Following Page

(*h*) Bad debts previously written off, but now recovered and added to a reserve.

In the case of a limited liability company, no items of the following nature will be treated as statutory deductions:—

(*a*) Preliminary expenses written off. These expenses include the cost of preparing and advertising the prospectus, and the cost of circulating it; the cost of drawing up and printing the company's memorandum and articles of association; fee and deed stamp duties; legal expenses; and the amount of any broker's or underwriter's commission.

(*b*) Expenses incurred in obtaining or re-arranging the capital of the company, or charges in connection with any other capital requirements.

(*c*) Goodwill written off.

In addition to the amounts which have been charged against the profits, the dyer may deduct any items of the following nature when computing his tax liability:—

(*a*) A sum representing the annual value of the business premises, providing no rent has already been debited.

(*b*) Amounts of cash received from sub-tenants, or rents received from property owned, providing such amounts have been treated as income in the accounts.

(*c*) Amounts which have been debited against a reserve account, or to a suspense account, but which could have been charged against the profits had the dyer preferred to do so.

The following example will indicate the practical method of preparing an account for income-tax purposes:—

A dyer in business on his own account is accustomed to balance his books on June 30, each year, and to prepare a profit and loss account showing the amount of net profit actually realized during the twelve months. His account covering the financial year to June 30, 1930, contained the figures given on the previous page and it is desired to ascertain the taxable profit, bearing in mind that the net assessment under Schedule A is £175.

The taxable profit would be determined by drafting an account in the form shown below.

It should be observed that the net Schedule A assessment has been deducted. If the cost of repairs to the premises are not charged against the periodical profits, the gross assessment may be deducted.

Ascertaining Taxable Profit from Cash Records

The dyer in a small way of business, who keeps merely a record of actual cash transactions in addition to the personal accounts of debtors and creditors, will find it much more difficult to determine his assessable profit than will the dyer who has kept a complete set of books in accordance with the principles of modern double-entry bookkeeping.

Making a Cash Summary

In such cases, the first step will consist of making out a summary of the cash received during the year, and a summary of the cash paid away during the same period, the cash-book items being classified under suitable headings and set down on a sheet of analysis paper. On the left-hand or debit side of this summary should appear the balance of cash as at the commencement of the year, followed by the cash sales, the credit sales, and any other receipts or income, while on the credit side the various management and working expenses, business charges, and other outgoings should be grouped under appropriate heads, varying according to the size of the business and the particular class of trade followed by the cash balance as at the close of the financial year. If the closing cash balance is greater than the balance at the beginning, the difference will have to be looked upon as profit for tax purposes, but if the balance has decreased, the difference may be treated as a loss.

When the summary of cash receipts and payments has been completed, a list of amounts owing by sundry customers and debtors should be prepared, also a list of amounts owing to creditors and trade suppliers. The total of the book debts outstanding should be compared with the sum owing by debtors at the commencement of the year, and if the total has increased, the difference will have to be considered as profit, although if the total has decreased, the difference may be deducted as a loss. In like manner, the total sum owing by the dyer to creditors and suppliers should be compared with the total amount outstanding at the beginning of the year, and if the figure has gone up, the difference may be treated as a loss, otherwise the difference must be dealt with as a profit for purposes of income tax.

Assessing Value of Stock

Before the taxable profit can be ascertained, it will be necessary to assess the value of the dyes, chemicals, mate-

Dr. INCOME TAX PROFIT AND LOSS ACCOUNT *Cr.*

	£	s.	d.		£	s.	d.
To Dividends received (tax deducted)	12	15	6	By Net Profit as per Ordinary P. & L. Acct.	403	19	4
" Rent received	72	10	0	*Add* Deductions not allowed:—			
" Schedule A Assessment (net)	175	0	0	Income Tax	11	10	0
" Balance, being Taxable Profit	416	3	10	Mortgage Interest	10	10	0
				Depreciation	25	0	0
				Goodwill written off	25	10	0
				Drawings	200	0	0
	£676	9	4		£676	9	4

An Example of an Income Tax Profit and Loss Account, Referred to in the Article

Dr. TABLE 1. RECEIPTS AND PAYMENTS ACCOUNT. *Cr.*

YEAR ENDED JUNE 30, 1930.

1929.		£	s	d.	1930.		£	s.	d.
July 1	To Balance	231	18	5	June 30	By Wages	1,675	9	5
1930.					"	" Purchases	2,811	14	4
June 30	" Takings	5,449	5	1	"	" Income Tax	14	7	3
"	" Rents Received	52	10	0	"	" Cotton Belting	35	19	0
"	" Dividends, less Tax.	11	2	6	"	" Advertising	75	15	6
"	" Profit on Sale of Drying Machinery	5	0	0	"	" Rent	300	0	0
					"	" Rates and Taxes	196	15	2
					"	" Gas, Water, etc.....	81	9	8
					"	" Cisterns & Cylinders.	72	4	6
					"	" Motor Car Repairs..	12	3	6
					"	" Sundry Trade Ex's ..	65	18	6
					"	" Balance	407	19	6
		£5,749	16	0			£5,749	16	0

rials and stores on hand, including the cost price of the work in progress. This will be done by making out an inventory, each item of stock being priced out at cost or market price, whichever is the lower, and if the total value at the end of the year is greater than the value of the stock on hand at the beginning, the difference will have to be looked upon as profit made during the year, although a decrease in total value may be treated as a loss. The following example will serve to indicate the best method of arriving at the figure of taxable profit from a summary of cash receipts and payments:—

A dyer established on his own account deems it unnecessary to keep impersonal accounts of his expenses, business charges, assets, and liabilities, etc., being quite content to book his actual cash incomings and outgoings and to keep a personal ledger containing the accounts of his credit customers and creditors.

SUM ON WHICH INCOME TAX IS PAID

He is accustomed to take stock at June 30 each year, and to prepare a receipts and payments account for the year, and he finds that his cash balance at June 30, 1930, was greater than his balance as at June 30, 1929, the difference being £176 1s. 1d. Taking this as a basis, he desires to ascertain the figure on which he will have to pay income tax, after providing for the following matters:—

(1) The value of the stock on hand at June 30, 1930, was £57 19s. 2d. more than the value of stock at June 30, 1929;

(2) The total sum owing to creditors and trade suppliers increased during the year by £33 16s. 8d.;

(3) The amount owing by customers and sundry debtors at the end of the year showed a deduction of £29 11s. 4d., as compared with the total book debts at the beginning of the year;

(4) The salary of the dyer, amounting to £250, is included in the "wages" item on the payments side of the cash summary; and

(5) The dyer resides on the business premises.

His cash summary for the year was made up as in Table 1:—

The taxable profit would be determined by preparing a special account in the form shown in Table 2:—

THE ANNUAL RENT

It will be observed that one-third of the annual rent of £300 has been added as profit for tax purposes. When the dyer resides on the business premises he is entitled to charge against his profit an amount not exceeding two-thirds of the rent, so that if the total rent has been debited, one-third should be written back for tax purposes.

Dr. TABLE 2. INCOME TAX ACCOUNT. *Cr.*

YEAR ENDED JUNE 30, 1930.

	£	s.	d.		£	s.	d.
To Increase in Creditors	33	16	8	By Increase in Cash Balance	176	1	1
" Decrease in Debtors	29	11	4	" Increase in Stock	57	19	2
" Rents Received	52	10	0	" Private Drawings	250	0	0
" Dividends Received	11	2	6	" One-third of Rent	100	0	0
" Profit on Sale of Drying Machinery	5	0	0	" Income Tax	14	7	3
" Balance, being Taxable Profit..	586	14	0	" Cisterns and Cylinders	72	4	6
				" Cotton Belting	35	19	0
				" Motor Car Repairs	12	3	6
	£718	14	6		£718	14	6

Methods of Determining and Recording Depreciation

Before the balance of profit realised by the dyer is withdrawn from the business for private purposes, or shared between partners or distributed among shareholders, an adequate sum should be charged for depreciation of machinery and other wasting assets which have been employed during the particular accounting period for profit-earning purposes. If this is not done, capital will most likely be withdrawn from the business, and further development seriously retarded.

The book value need not represent the actual market value of an asset for the simple reason that the asset has been acquired for use, and not for sale, but the amount standing to the debit of the machinery account, plant account, fittings and fixtures account, etc., will represent so much unrecovered investment for which the business will have to be reimbursed by charging against each year's profits a percentage of the first or original cost in accordance with a predetermined scale. The three principal methods of providing for depreciation are as follows:—

(1) An equal proportion of the first or original cost of the asset may be written off each year and debited to profit and loss, so that at the termination of the life of the particular assets as a profit-earning factor, the book value will be reduced to nil.

(2) A definite percentage of the gradually diminishing book value of the asset may be written off each year and charged against the periodical profits, so that at the end of the effective life of the asset, the value standing in the books will represent a purely realisable or break-up value.

(3) The asset may be re-valued, and the actual decrease in value charged against the current year's profits in one amount.

Examples illustrating the practical application of each of these methods are given below:—

Example 1.—On January 1, 1929, the value of dyeing and textile printing machinery was shown in the books at £400, and it is estimated that at the end of five years this machinery will have to be replaced by other apparatus possessing a greater productive efficiency. It is desired, therefore, to apportion the book value over the remaining five years by charging £80 against each year's profits. At the end of the period, the asset account would appear as shown in the tables on this page.

The sum written off each year would be transferred from the machinery account to the debit side of the depreciation account, the balance of which would appear on the debit side of that year's profit and loss account, and when drafting the balance sheet the book value, less depreciation written off to date, would appear on the assets side.

Example 2.—The book value of plant on January 1, 1929, was £500, and this plant is estimated to be worth about £164 at the end of its effective life in five years' time. As the cost of plant repairs will be heavier during the later years, it is desired to provide for depreciation by writing off a percentage each year, so that the combined charge for repairs and depreciation will not be too excessive in any one year. In such a case as this, the second method referred to above should be adopted, the asset account at the end of the five years containing the figures shown in the tables.

Example 3.—For the purpose of arriving at a figure which will be satisfactory to all concerned, it is decided to subject certain fixtures and fittings to a re-valuation by an expert, and to make any necessary adjustment in the books account. On January 1, 1929, the fixtures and fittings account showed a debit balance of £180 from which £25 was deducted at December 31, 1929, and charged against the profits, but the re-valuation on July 17 showed the fixtures and fittings to be worth only £120. After effecting the necessary adjustments, the asset account in the private ledger would appear as shown.

It is very necessary that a proper distinction should be drawn in the books of account between expenditure of a capital nature and expenditure which is a direct charge against the trading, and the next instalment of this series will show how this may be best effected.

(To be continued)

Dr. FIXTURES AND FITTINGS ACCOUNT *Cr.*

1929.	£	s.	d.	1929.	£	s.	d.
Jan. 1 To Balance	180	0	0	Dec. 31. By Depreciation	25	0	0
				" " Balance c/d	155	0	0
	£ 180	0	0		£ 180	0	0
1930.				1930.			
Jan. 1. To Balance b/d	155	0	0	July 17. By Depreciation	35	0	0
				" " Balance c/d	120	0	0
	£ 155	0	0		£ 155	0	0
1930.							
July 17. To Balance b/d	120	0	0				

Table to Example 3

Dr. BLEACHING AND CALICO PRINTING MACHINERY ACCOUNT *Cr.*

		£	s.	d.				£	s.	d.
1929.					1929.					
Jan. 1.	To Balance	400	0	0	Dec. 31.	By Depreciation		80	0	0
					"	" Balance c/d		320	0	0
		£ 400	0	0				£ 400	0	0
1930.					1930.					
Jan. 1.	To Balance b/d	320	0	0	Dec. 31.	By Depreciation		80	0	0
					"	" Balance c/d		240	0	0
		£ 320	0	0				£ 320	0	0
1931.					1931.					
Jan. 1.	To Balance b/d	240	0	0	Dec. 31.	By Depreciation		80	0	0
					"	" Balance c/d		160	0	0
		£ 240	0	0				£ 240	0	0
1932.					1932.					
Jan. 1.	To Balance b/d	160	0	0	Dec. 31.	By Depreciation		80	0	0
					"	" Balance c/d		80	0	0
		£ 160	0	0				£ 160	0	0
1933.					1933.					
Jan. 1.	To Balance b/d	80	0	0	Dec. 31.	By Depreciation		80	0	0
		£ 80	0	0				£ 80	0	0

Dr. CHEMICAL PLANT ACCOUNT. *Cr.*

		£	s.	d.				£	s.	d.
1929.					1929.					
Jan. 1.	To Balance	500	0	0	Dec. 31.	By 20% Depreciation		100	0	0
					"	" Balance c/d		400	0	0
		£ 500	0	0				£ 500	0	0
1930.										
Jan. 1.	To Balance b/d	400	0	0	1930.					
					Dec. 31.	By 20% Depreciation		80	0	0
					"	" Balance c/d		320	0	0
		£ 400	0	0				£ 400	0	0
1931.										
Jan. 1.	To Balance b/d	320	0	0						
					1931.					
					Dec. 31.	By 20% Depreciation		64	0	0
		£ 320	0	0	"	" Balance c/d		256	0	0
								£ 320	0	0
1932.										
Jan. 1.	To Balance b/d	256	0	0						
					1932.					
		£ 256	0	0	Dec. 31.	By 20% Depreciation		51	4	0
					"	" Balance c/d		204	16	0
1933.										
Jan. 1.	To Balance b/d	204	16	0				£ 256	0	0
		£ 204	16	0	1933.					
					Dec. 31.	By 20% Depreciation		40	19	2
					"	" Balance		163	16	10
1934.										
Jan. 1.	To Balance	163	16	10				£ 204	16	0

Above—Table to Example 1; *Below—Table to Example* 2

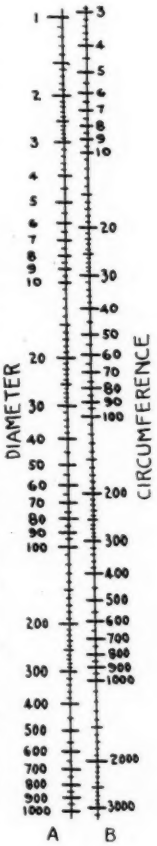
Diameter or Circumference ot Any Circle

By W. F. SCHAPHORST, M.E.

BY means of this simple chart any one can instantly find the circumference of a circle when the diameter is known. No tables and no figuring is necessary.

For example, if the diameter is 8 ft., find the 8 in Column A and glance across to Column B, and there is the answer—a little over 25 feet.

It will be observed that the range of this chart is from 1 to 1,000, but it is not limited to 1,000. If the diameter should be 10,000 it is simply necessary to add another digit to the circumference. Thus if the diameter is 8,000 ft. the circumference will be a little more than 25,000 ft. If the diameter is in inches the circumference will, of course, be in inches. If the diameter is in feet, the circumference will also be in feet. And so on.



Likewise if the circumference is known, simply glance from Column B over to Column A and there is the diameter.

The advantage of this chart over tables is that the chart takes care of fractional quantities as well as whole numbers. Thus, if the diameter is 61, or 72, or 83, or 94, the circumference is immediately available. Of course, the results are not as accurate as a table nor as accurate as correct hand computation, but for approximate work there is nothing better. There is nothing in the world, so far as I know, that occupies so little space as this chart and that will do so much, considering its limitless range.

New Color Card

In a new card Helindon Colors on Loose Wool for Woolen Blankets, given out by the General Dyestuff Corporation, a number of Standard Shades are shown as used in the manufacturing of blankets. Their excellent fastness to light, washing, and fulling, fastness to bleaching either with Sulphur or Peroxide, combined with the fact that the dyeing is done at 130-150° F., without any boiling and the material kept in excellent condition, is said to make Helindon colors especially suitable for the blanket industry. I. G. 452.

Butterworth Exhibit

H. W. Butterworth & Sons Company's exhibit at the Knitting Arts Exhibition, Commercial Museum, Philadelphia, April 13-14-15-16-17 will consist of:

Skein Machines—Hoist and Non-Hoist Type.

Hoist Type Rotary Machines—for dyeing hosiery in small lots.

Sample Skein Dyeing Machine—two stick rotary principle.

Hosiery Dyeing Machines—2-pocket baffle plate rotary type. Improved 4-pocket rotary type. Paddle wheel type. Hoist Rotary—large lot type. Special hand hoist type rotary for dyeing hosiery in small lots.

The Laboratory Model machine is sure to prove interesting because of the fact that it enables hosiery dyers to conduct color experiments quickly and at low cost.

Representing the Butterworth organization at the Exhibit will be: A. W. Butterworth, President; H. W. Butterworth, Sr., Chairman of the Board of Directors; J. Ebert Butterworth, Harry W. Butterworth, Jr., De Haven Butterworth, Albert Molt, W. E. H. Bell, Wm. Yates.

Du Pont Exhibit

The Du Pont Rayon Company will occupy Booths Nos. 149, 150, 173 and 174 at the Knitting Arts Exhibition which will take place on April 13th to 17th at the Commercial Museum in Philadelphia.

The display will consist of a comprehensive showing of knitted fabrics and garments.

Mr. C. G. Hookey, district sales manager, will be in charge. Messrs. C. G. Adams, C. S. Marshall and R. C. Martin will be in attendance.

William A. Hamann Retires

A career of almost half a century in the chemical manufacturing industry was brought to a close with the recent retirement of Mr. William A. Hamann, as chairman and director of the Roessler & Hasslacher Chemical Co., Inc., New York, N. Y. Retirement was due to a desire to give up active business.

It was in 1885 that Mr. Hamann joined Roessler and Hasslacher, as the present company was then known. This was four years before the firm changed its name to The Roessler and Hasslacher Chemical Co. His early years with the company were spent in the business department, as clerk, shipper and many other jobs. This varied experience stood Mr. Hamann in good stead for as the company grew, Mr. Hamann gradually assumed greater responsibilities. He was successively secretary, treasurer, vice president, and in 1926, president of the company. In the early part of 1928, Mr. Hamann became chairman of the board.

Mr. Hamann has not given out his plans, other than travel and a more active interest in Elka Park, a cooperative summer home enterprise, located in the Catskills, of which he has been treasurer for a good many years.

New Monel Metal Product at Knitting Arts Exhibition

Seamless Monel Metal tubing, which is said to overcome certain objections to welded tubing for heating coils, pipe lines, and other uses in textile plants, will be shown for the first time at the Knitting Arts Exhibition at the Commercial Museum, Philadelphia, Pa., April 13th to 17th.

The tubing will be shown in connection with a general exhibit on corrosion and quick color changing problems in the dyehouse.

A number of the newer uses of Monel Metal will be featured also, including extractor baskets, silk soaking tubs, topping tables, knitters, benches, skein reels and dyesticks, moistening equipment, seamless utensils, and the like.

The exhibit will be under the direction of E. A. Turner of the International Nickel Company, assisted by C. J. Bianowicz, T. E. Lagerstrom, A. H. Galley, F. L. LaQue, and J. F. Smith.

Boston Bowlers Banquet

A very enjoyable evening was spent by the 600 members and guests of the Boston Dyestuffs Bowling League at their annual banquet which was held on Saturday evening, March 21st, at the Bradford. After an excellent dinner at 6:30, prizes were distributed and entertainment provided until 10 o'clock. B. C. Bond, of the Dyestuffs Corporation of America, presided and Frank Benvie, of General Dyestuffs Corporation, was in charge of the entertainment. The United Aniline bowlers, captained by Joseph Travers, were the champions of the past season, and were presented with a handsome silver cup for their efforts. National Aniline won second place honors and a cup, and Dyestuffs Corp. won a shield and third place. Highest team totals were made by the Calco Chemical team. Individual prizes were won by the following: Hansis of National, high average; Lee of D. C. A., second high average; Morris of United Indigo, high three strings; Wood of United Aniline, high single; Craft of du Pont, improvement. Officers for the next season will be Joseph Travers, United Aniline, President; Wm. Sweeney, General Dyestuff, Treasurer, and John Nolan, National, Secretary. Alvah H. Pierce of General Dyestuff, on behalf of the executives present, praised the league for its promotion of good will among the employees of the industry, and wished it continued success.

Annual Phi Psi Convention

The Twenty-Ninth Annual Convention of the Phi Psi Fraternity, a national textile fraternity, will be held under the auspices of the Boston Alumni Chapter at the Bradford Arms, Sagamore, Mass., on May 8th, 9th and 10th.

The entire hotel has been reserved for these three days and it is expected that there will be a large gathering of textile men from all parts of the country.

Willis Appointed Chairman of Raw Cotton Committee

Mr. H. H. Willis, Director of the Clemson Textile Department, has recently been appointed Chairman of the Raw Cotton Committee of D-13, Textile Section, of the American Society for Testing Materials. This committee since its organization has been ably headed by Director H. W. Barre, of the South Carolina Experiment Station, who recently resigned the chairmanship.

Mr. Barre was very successful in organizing a strong committee to carry on the work and the various phases relating to production have been considered. Mr. Willis and his committee will take up the phases pertaining to textiles. Mr. Willis has just returned from New York City where he attended a special meeting of this committee.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED

Secretary-Stenographer—8 years' experience with importing and domestic Chemical and Dyestuff manufacturing concern, desires a position in similar capacity wherein excellent knowledge of sales operations may be of service. Address: Classified Box No. 668, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Executive Chemist—German graduate; fifteen years' experience intermediates, Dyestuffs, etheric oils, former executive abroad; five years with American dyestuff corporation, wishes position as research and plant chemist or technical adviser to executive. Would consider temporary connection for special research problems. Address: Classified Box No. 669, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Textile Colorist for 12 years, selling soluble oils, dyestuffs and specialties, desires position with manufacturer or in purchasing department of textile mill. Address: Classified Box No. 670, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.